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Experiments on Humidifying Air at the Oliver Wendell Holmes School, Boston, Mass.

TESTS THAT SHOW TEMPERATURE AND HUMIDITY MUST BE UNDER CLOSE AND ACCURATE CONTROL.

BY CHARLES F. EVELETH,
Heating and Ventilating Engineer for Boston Schoolhouse Department.

EDITOR'S NOTE.—It will be recalled that at the last annual meeting of the heating engineers' society a number of charts were exhibited in connection with the humidity tests being conducted at one of the Boston schools by Charles F. Eveleth and Dr. Thomas W. Harrington. These have now been made the basis of a special report to the Schoolhouse Department of Boston which is given in full herewith.

It is only within very recent times that any serious attention has been paid either by physicians or by heating and ventilating engineers to the effect which the relative humidity has upon the comfort and health of people who by force of circumstances are compelled to daily gather together in large numbers in such places as factories, mills, schools, colleges and the like. Very little direct evidence has ever been published either, to prove or disprove the value of humidification, and those who have spoken in favor of it have argued from an academic standpoint, rather than in the light of any specific data.

The Schoolhouse Commissioners of the City of Boston, acting with the School Committee, set aside an appropriation which enabled the writer, in conjunction with Dr. Thomas W. Harrington, to purchase apparatus and carry on a series of experiments covering a period of about three months, for the purpose of obtaining definite information upon the subject.

OBJECTS OF EXPERIMENTS.

Briefly stated, the objects of the experiment were as follows:

1.—To find whether the mental and physical conditions of the occupants of a school are improved by increasing the relative humidity of the air in the rooms.

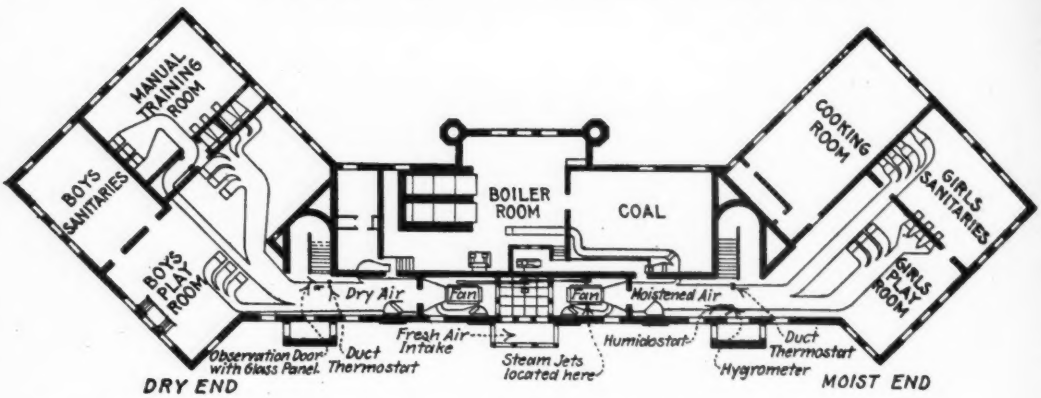
2.—To determine at what point the relative humidity should be maintained, to ensure the greatest degree of comfort.

3.—To find how much lower the temperature may be comfortably maintained when the relative humidity is increased.

4.—To obtain a record of the humidity during the winter months of a school building when heated and ventilated in the ordinary manner, by means of a plenum system.

5.—To see whether it is practicable to moisten the air by means of a system jet and keep the humidity within reasonable control.

In order to make a comparative study of the effect of increased humidity upon the physical and mental conditions



BASEMENT PLAN, OLIVER WENDELL HOLMES SCHOOL, SHOWING EQUIPMENT FOR HUMIDITY TESTS.

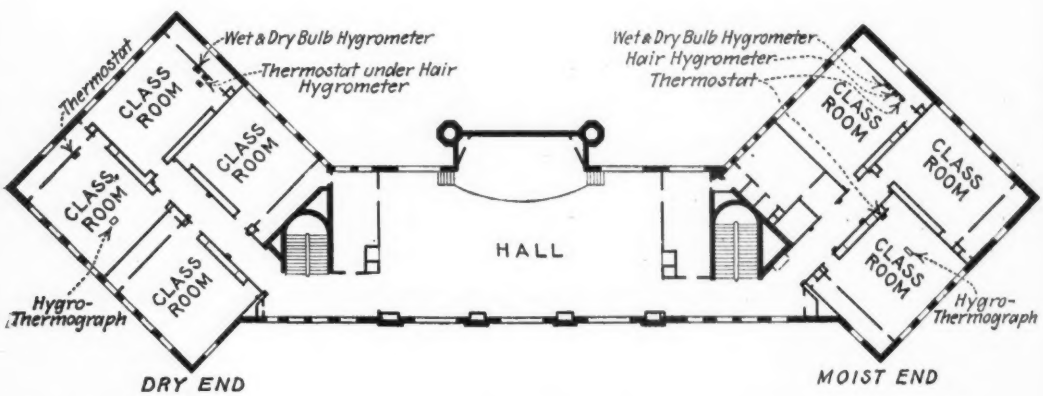
observations should be made upon children who live and move in the same walks of life, attend the same school and occupy similar grades.

The Oliver Wendell Holmes School was selected as being the best adapted for the purpose of conducting the tests. It contains twenty-four class-rooms beside a manual training room and cooking room. On the basis of forty pupils per class-room it has a capacity of nearly 1,000 children. The building is of brick, three stories in height, of the so-called fireproof construction throughout. The floors and stairs are of reinforced concrete, all of the principal rooms having upper floors of hard wood laid on screeds. The partitions are built of terra cotta blocks and plastered. It contains a plenum system of heating and ventilating, the air supply to each half of the building being furnished by a steel plate fan. The classes are so arranged that corresponding grades of pupils occupy similar rooms in each half of the building.

The second floor plan shows very clearly the shape of the building, the arrangement of the rooms and the exposure. The third floor is similar, the assembly hall being two stories high. The space on the first floor corresponding to the hall is divided into class-rooms.

ARRANGEMENT OF HEATING AND VENTILATING APPARATUS.

The arrangement of the heating and ventilating apparatus is outlined in the basement plan. Steam is supplied by two horizontal return tubular boilers to a low pressure steam engine, which is belt-connected to two single inlet 7-ft., steel plate fans, each furnishing air to one-half of the building. The engine ex-



SECOND FLOOR PLAN, OLIVER WENDELL HOLMES SCHOOL, AS EQUIPPED FOR HUMIDITY TESTS.

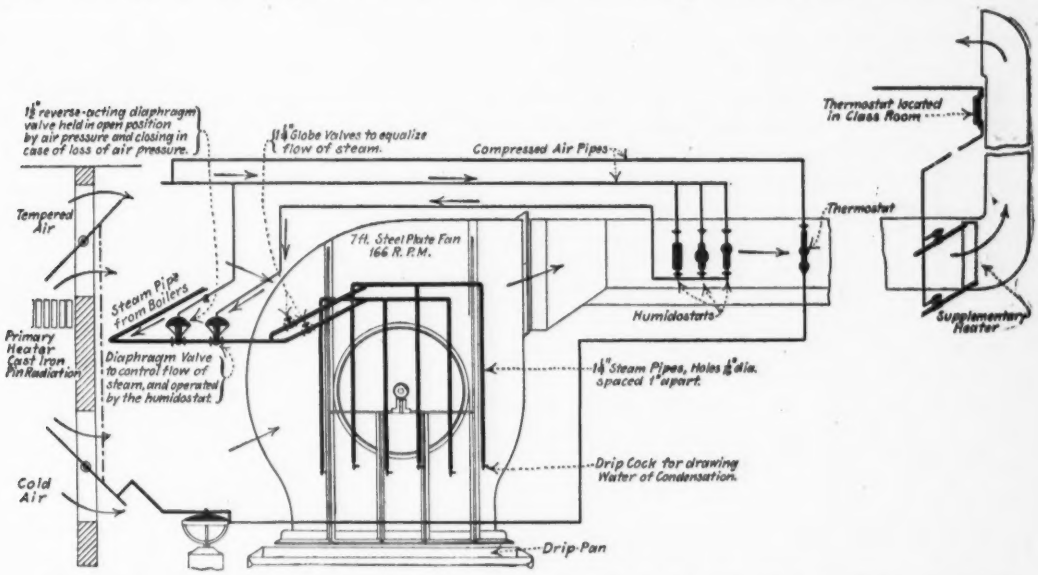
haust is turned into the heating system and this is supplemented by live steam passing through a reducing pressure valve. The water of condensation is returned to the boilers by an automatic pump and receiver. The class-rooms and the assembly hall are heated and ventilated by warm air. Only the small administration rooms and corridors contain direct radiators. Fresh air is taken into the system through a hooded intake at the center of the building and is warmed by a primary heater of cast-iron indirect pin radiators.

The temperature is maintained at a uniform point, varying from 60° to 70° F, as the occasion demands, by mixing dampers operated by graduated action thermostats, one being placed in the air

the sketch of humidifying apparatus. The warm air enters each class-room through an opening about 8 ft. above the floor and the foul air is withdrawn by gravity through a vent outlet at the floor, both being situated along the same wall. These are shown on the second floor plan.

Before beginning the experiments, all the dampers and deflectors were so adjusted as to furnish an air supply to each room on the basis of 30 cu. ft. per minute per occupant.

The relative humidity of the air supply to the north end of the building was raised by introducing moisture in the form of steam, while that of the south end remained in its natural state, separate. Readings were taken of the humid-


1½" reverse-acting diaphragm valve held in open position by air pressure and closing in case of loss of air pressure.
1¼" Globe Valves to equalize flow of steam.
Compressed Air Pipes
Thermostat located in Class Room
Tempered Air
7 ft. Steel Plate Fan 166 R.P.M.
Thermostat
Steam Pipe from Boilers
Humidostats
Supplementary Heater
Primary Heater Cast Iron Pin Radiation
Diaphragm Valve to control flow of steam, and operated by the humidostat.
1½" Steam Pipes, Holes ¼" dia. spaced 1" apart.
Drip Cock for drawing Water of Condensation.
Cold Air
Drip Pan

HUMIDIFYING APPARATUS AND METHOD OF TEMPERATURE CONTROL, OLIVER WENDELL HOLMES SCHOOL.

beyond the discharge from each fan, as shown on the drawing.

The air is conducted through galvanized-iron ducts on the basement ceiling to the foot of the risers leading to the individual class-rooms, where it is further heated to a temperature of 95° F. by supplementary stacks of indirect radiators, each under the control of a thermostat placed in the room.

The arrangement of mixing dampers and duct thermostat and the location of the supplementary heater and room thermostat are shown somewhat in detail on

ity and temperature of the air in the duct and of the class-rooms of each half of the building. The children of similar grades on the moist and dry side were subjected to similar mental tests, and a record was kept of both the physical condition and the percentage of attendance.

NO ROOM FOR AIR WASHER.

Owing to lack of space an air washer could not be installed in connection with the existing apparatus, without making too many structural changes, and the steam jet was found to be the only

moistening device which could be economically applied. The accompanying sketch shows the essential details. Six 1¼-in. pipes spaced an equal distance apart were suspended in front of the inlet of one of the fans. A single row of holes 1/16 in. in diameter and 1 in. apart were drilled in each of the two outer pipes, the others having two rows similarly placed. The pipes were connected up in two groups in such a way as to equilize the flow of steam as nearly as possible. The supply pipe was connected to the main steam drum, taking steam at boiler pressure. This was partially throttled by a valve near the boilers, further reduction being made, as the occasion required, by the globe valve in the branch supply to each group of perforated pipes.

The volume of steam issuing from the openings was regulated by a diaphragm valve operated by compressed air taken from the automatic temperature control system and controlled by a humidostat placed in the main warm-air duct. The exact location is shown on the basement plan. In order to prevent flooding of steam in case of failure of the air pressure, a reverse acting diaphragm valve was also installed. This valve was normally closed by means of a spring and opened when the proper air pressure was maintained on the system. A three-way cock placed in the air piping to the diaphragm top of the valve permitted its operation by hand. The apparatus could thus be easily started and stopped by manipulating the cock. The water of condensation which always formed when the apparatus was first turned on, and which would slowly collect during use, was drawn off through a lever-handle air cock at the bottom of each pipe and caught in the drip pan underneath.

HUMIDOSTATS USED.

Humidostats of three different makes were connected up to the air piping, shut-off cocks being installed to cut out any two of them as desired. The action of the instrument is somewhat similar to the thermostat and depends upon the change in shape of a piece of cross-grained hard wood, due to presence or absence of moisture. Two of them had a graduated action causing the control valve to slowly turn on or off the steam. The other was of the positive type and its effect upon the movement of the valve disc was very much like that of a positive thermostat upon a set of mixing dampers, viz., either completely opened or closed, there being no midway position. There was either a full flow of steam or none, and the results were far from satisfactory. One of the other instruments, having a graduated action, gave excellent satisfaction, the curtain of vapor in front of the fan inlet being very uniform and changing gradually with the varying demand for moisture.

HOW THE APPARATUS WAS ADJUSTED.

The method of adjusting the apparatus was as follows: The duct thermostat controlling the mixing dampers was set to keep the tempered air in the duct at approximately that desired in the class-rooms, viz., a dry bulb temperature of from 63° to 67° F. and extreme care was used to regulate it closely. The humidostat was then adjusted to maintain the desired relative humidity at this temperature. The temperature of the class-room and of the air in the duct where the control apparatus was located being the same, the relative humidity of the room would correspond to that in the duct. The supplementary heater had no influence upon the quantity of moisture introduced, as it was beyond this point.

When starting up in the morning it was found necessary to turn on the steam jet gradually, as the instrument would not at once assume proper control of the jet. If this was not done the rooms became very uncomfortable on account of excessive moisture.

Before beginning the experiments the water was drawn off completely from both the boilers, the piping was thoroughly blown off and fresh water introduced to prevent as far as possible any odor due to oil or foreign matter. Notwithstanding this, a slight odor, somewhat objectionable, was noticeable on first entering the class-room when the relative humidity was over 55%.

In the basement fresh-air duct on each side of the building there were placed wet and dry bulb thermometers

of a pattern similar to those in use by the Weather Bureau of the United States Government, and also a hair hygrometer. A tight-fitting glass door of ample size permitted the instrument to be read from the outside of each duct, eliminating as far as possible any exterior influences. Observations were taken each morning about ten o'clock, after the apparatus had assumed normal working conditions. The hair hygrometer was set daily to correspond to the readings obtained from the wet and dry bulb thermometers. This instrument was installed particularly for use by the janitor, as it indicated directly the humidity in per cent. and enabled him to determine whether the apparatus was working properly.

In rooms 12 and 17 on the second floor, located respectively on the dry and moist ends, were placed recording hygrothermographs from which complete autographic records were obtained of the temperature and relative humidity, the charts being replaced weekly. Each instrument was securely mounted upon a wood shelf fastened to a standard which was screwed to the floor and guyed with wires and turn-buckles to prevent vibration. It was necessary to place it about 6½ ft. above the floor to prevent interference by the pupils, and care was taken to locate it in such a position as not to be affected by the incoming fresh air. The rooms were alike in respect to outside wall and glass area, and as they had no direct sunlight during the day it was not necessary to take into account the effect of the sun's rays upon the readings.

On the third floor, in rooms 20 and 22, wet and dry bulb thermometers were placed similar to those described above. They were located on an inside wall near the inner corner of the room and at about the height of the hygrothermographs.

The test was started on January 3, 1912, and terminated on March 28. As stated above, readings of the various instruments of the fan speed and steam pressure were taken each morning, generally about 10.30, after the humidifying apparatus had assumed its normal working condition. The readings of the hygrothermographs were checked up by a sling psychrometer and a standard thermometer and the instruments readjusted if necessary. The class-rooms were

AVERAGE READINGS FOR FEBRUARY AND MARCH, 1912.

Temperature and Humidity in Fresh-Air Duct.

	Moist End.			Dry End.		
	Dry Bulb. Deg. F.	Wet Bulb. Deg. F.	Relative Humidity, Per Cent.	Dry Bulb. Deg. F.	Wet Bulb. Deg. F.	Relative Humidity, Per Cent.
January	68.2	56.1	46	67.7	49.1	21.2
February	66.1	55.1	44.3	67.5	49.9	24.4
March	65.1	55.2	52.6	66.3	52.8	34.8

Temperature and Humidity in Class-Rooms 12 and 17 from Hygrothermographic Charts.

	Room 17, Moist End.		Room 12, Dry End.	
	Temperature, Deg. F.	Relative Humidity, Per Cent.	Temperature, Deg. F.	Relative Humidity, Per Cent.
January	62.2	50.1	69.4	34.3
February	65.0	41.2	68.4	23.6
March	65.1	47.3	68.1	32.2

Temperature and Humidity in Class-Rooms 20 and 22 from Wet and Dry Bulb Thermometer.

	Room 22, Moist End.			Room 20, Dry End.		
	Dry Bulb. Deg. F.	Wet Bulb. Deg. F.	Relative Humidity, Per Cent.	Dry Bulb. Deg. F.	Wet Bulb. Deg. F.	Relative Humidity, Per Cent.
January	67.4	57.2	53.4	69.5	54.1	34.4
February	68.5	56.5	47.1	68.2	53.4	35.8
March	67.6	57.8	52.6	67.8	55.4	44.3

warmed and ventilated by the fan system alone, no outside ventilating by opening windows being permitted.

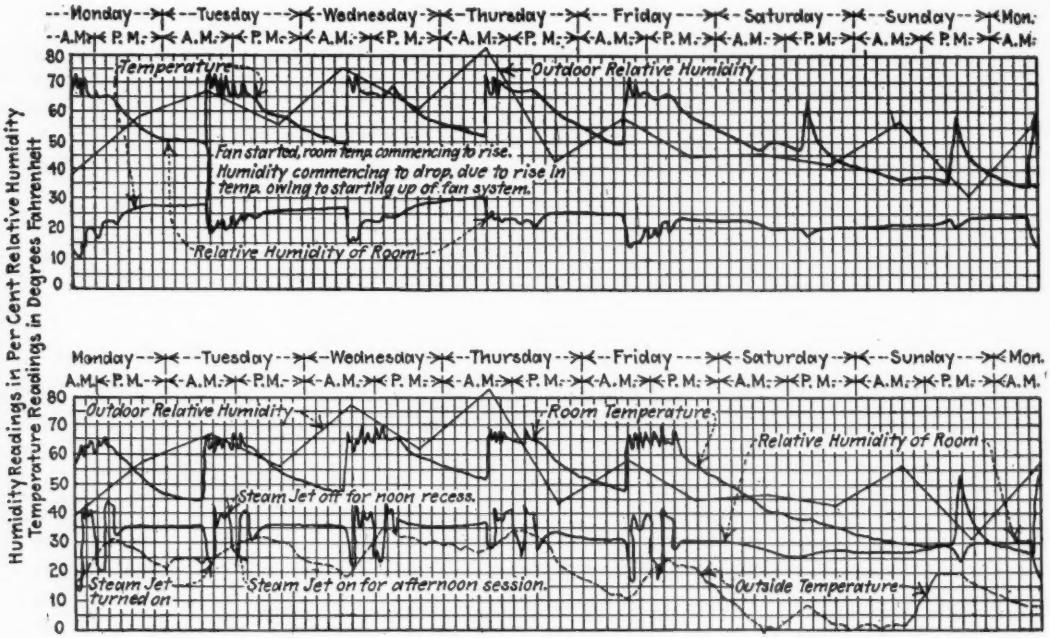
The average results for the months of January, February and March are given below. Those of the outdoor humidity were obtained from the United States Weather Bureau in this city, and taken at 8 a. m. daily.

Outdoor Humidity.

	Outdoor Humidity	
	Day Reading, 8 a. m. Per Cent.	Night Reading, 8 p. m. Per Cent.
January	71.3	63.5
February	64.8	55.7
March	70.7	63.5

perature, and also the outdoor relative humidity from daily observations made at 8 A. M. and 8 P. M., both taken from the weather bureau records. The charts bring out very clearly the intimate relationship between temperature and humidity and it is perfectly evident that no system of air moistening will prove successful unless both the temperature and the humidity are under close and accurate control.

The chart of boiler pressures taken from the recording steam gauge, and covering the same period, is perhaps typical of the lack of care taken by some janitors in operating their boilers. Such a variation in steam pressure must



CHARTS SHOWING TEMPERATURE AND HUMIDITY READINGS IN CLASS ROOMS NO. 12 AND NO. 17, FEB. 5 TO FEB. 12, 1912. ALSO OUTDOOR TEMPERATURE AND HUMIDITY FROM WEATHER BUREAU REPORTS.

Upper Chart, South End of Building, Room No. 12, Dry.
Lower Chart, North End of Building, Room No. 17, Moist.

RESULTS AS SHOWN BY CHARTS.

We have reproduced charts taken from the hygrothermographs in corresponding rooms on the moist and dry ends of the building for the week of February 5 to February 12, 1912, which represent the events taking place within the rooms during this period. For the purpose of comparison we have plotted the hourly readings of the outdoor temnecessarily affect the speed of the engine and the resulting air delivery to the rooms.

The diagram of indoor and outdoor relative humidities is not strictly accurate, the outdoor readings being taken at 8 A. M. while the others were made about two hours and one-half later. It is submitted to show the wide variation taking place out of doors and to bring

out graphically the additional moisture introduced into the rooms on the wet side.

The average results of the experiments may be summed up as follows:

(*a.*) With the outside temperature ranging from 0° to 10° above, precipitation was observed on the windows in the moist end of the building when the humidity was 40% and over. The teachers were inclined at the outset to raise some objections, but became accustomed to the conditions after a short time.

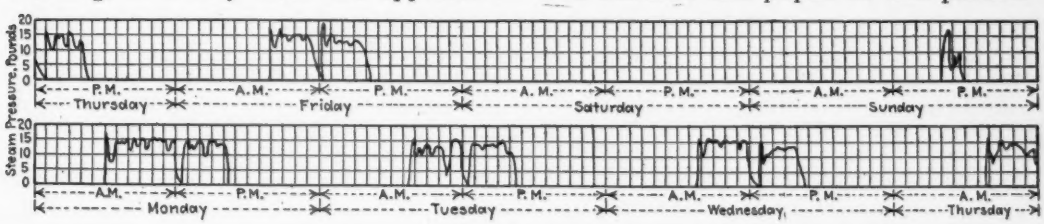
(*b.*) In the room on the north end of the building it was quite apparent that there was less body odor, so called, than on the dry end.

(*c.*) An increase in temperature from 4° to 5° was far more apparent on the moist side than on the dry.

(*d.*) Complaint was raised when the apparatus was first turned on each morning, of a very close and oppressive feeling in the rooms, and also an objectionable odor. Upon investigation it was found that the humidostat did not at once act upon the control device, and too much steam was introduced into the air, thereby raising the humidity far above the proper point. By checking the flow at the beginning this was almost entirely overcome.

Originally the room thermostats were mounted directly upon the slate blackboard, causing a decided overheating of the rooms Monday mornings, due to influence of cold walls upon the thermostats. This trouble was overcome to a certain extent by mounting the thermostats upon wood backs, thus insulating the metal from the blackboard. The cause for a cold building on Monday morning is very clearly shown if a moment's study is given to the reproduction of the hygrothermograph chart and the plot of boiler pressures. The latter indicates that steam was kept up only about 8½ hrs. each school day, none on Saturday and a little on Sunday afternoon. During the seven days practically three-quarters of the time no pressure was registered on the gage. The curved lines of drop in temperature at night are very similar for the several periods of school session. On Saturday night, however, with the outside temperature hovering around zero, the room dropped below freezing, remaining so for a long period of time.

On Sunday afternoon the apparatus was started up with a corresponding rise in temperature, and the quick recovery on Monday morning showed that a sufficient amount of radiation had been provided to bring up the temperature of the air in the room. It is, of course, evident that a greater time must elapse before the walls, floors, ceilings and furniture become heated to the same degree. The teachers and pupils of this particular school have complained repeatedly of the discomfort arising from the cold floors and furniture on Monday. The remedy is to be found in disciplining the janitor, and there was a marked improvement each morning when the autographic evidence was submitted to the proper authorities. The moral effects of a recording pressure gage and a recording thermometer are invaluable in maintaining proper operation of heating plants.



RECORD OF BOILER PRESSURE, MONDAY, FEB. 5, 1912 TO MONDAY, FEB. 12, 1912.

(*e.*) While the heating apparatus in the average school may perhaps be operated a greater number of hours in the week than the one under discussion, nevertheless an ample factor of safety ought always to be used in figuring radiating surface to allow for quick heating in the morning.

The results obtained when humidifying the air by means of a steam jet lead us to the following conclusions:

First.—To secure the greatest comfort, the relative humidity should not exceed 55%; somewhere betwen 45 and 50% is probably the best range.

Second.—With the humidity at 55% the temperature of the room should never rise above 65° F. A temperature of from 61° to 62° will give better results.

Third.—Moistening the air up to 40% or above should never be attempted unless both the heating system and the humidifying apparatus can be kept under close control. With a room temperature of from 70° to 75°, and a relative humidity of 50%, there is a very pronounced feeling of oppression and physical discomfort, as well as a perceptible odor which is disagreeable.

If the heating apparatus does not have automatic temperature control, the regulation being in the hands of the teacher or janitor, there will be many times when it will rise above 70°. Under such conditions it is not wise to increase the humidity of the air much over 35%, and we should be inclined to omit it altogether.

No system of air moistening will prove successful unless both the temperature and the humidity are under close and accurate control. A jet of steam blown into the incoming air without some forms of close regulation is at best a very crude affair. While the introduction of steam in moderate quantities may seem to the average layman to meet all of the requirements, it is of doubtful value, and when delivered in large amounts is liable to produce great discomfort.

Doctor Harrington submitted the following reports of the effect of increased humidity upon the mental and physical conditions of the pupils:

First.—On the basis of similar mental tests conducted upon pupils occupying similar grades on both the moist and dry sides of the building no appreciable difference was found.

Second.—The three rooms on the moist side had a percentage of attendance of 100. The percentage of attendance of all teachers on the moist side was 100; on the dry side the percentage of attendance of pupils was 97.

Ventilation and Recirculation

By Dr. Luther H. Gulick.

Read at the Fourth International Congress on School Hygiene, Buffalo, N. Y., Aug. 25-30, 1913.

Prevalent dissatisfaction with ventilation is acute. Such men as Dr. John W. Brannan, and Dr. W. Gilman Thompson are saying that the more perfect the system the worse the results in the great New York hospitals under their charge. The trouble does not rest primarily either with the ventilating apparatus nor with its operation. The trouble is that we hygienists have set up false standards. We have said, give each pupil 3,000 cu. ft. of outdoor unbreathed air per hour. We now know that the important thing is not either the quantity or the history of the air—the important thing is its condition. We have striven for absolute evenness of temperature although we know well that variation in temperature is a necessary element in vasomotor stimulation. We have been extreme in our endeavors to avoid air that has already been used. With the knowledge and experience now at our disposal it appears that under many conditions the best results can be secured by using the same air over and over again—that is, by recirculation.

TWO WAYS IN WHICH AIR SERVES THE BODY.

The great change in our standards is due to a new realization of the purposes of ventilation. The air serves the body in two more or less overlapping groups of ways—one relates to being the means of the gaseous exchanges of the body—the other relates primarily to heat control.

In order that the gas exchanges of the body should be perfectly performed it is

necessary that the air be pure; *i. e.*, practically in those proportions usually found in nature. No ventilation is needed to bring about this result. This will take care of itself.

The most recent and exhaustive work on this subject is "The Composition of the Atmosphere," by Francis G. Benedict, Director, Nutrition Laboratory, Carnegie Institution. He says in a personal letter summarizing his published findings, "The amount of carbon dioxide and oxygen I found on Washington Street, Boston, in the most crowded part of the city in the *middle* of the day time was *exactly* the same as that found in the *middle* of the Atlantic Ocean. Also, when I went into the subway shortly after the rush hour, the carbon dioxide in the air was but 0.06, and the oxygen, 20.90, as against surface air 0.03 and 20.93. Similarly in the New York subway, at the Grand Central Station and up on 96th Street, or along there we found 0.06 and 20.90, respectively, showing that there was a very slight vitiation of the air, and there must have been even in these enclosed tubes, tremendous movements of air. . . . "In fact, I believe there is no evidence whatsoever to show that there is any possible increment in carbon dioxide obtaining in school rooms or any possible decrease in oxygen obtaining in school rooms, that, by the widest stretch of imagination, could have any possible effect upon the health of the pupils."

The heat control of the body is influenced by the *condition* of the atmosphere in which the body is immersed. This is exceedingly variable and it is to bring about the best *conditions* of air to which ventilation should address itself. To repeat this fundamental change of standards, ventilation seeks to control the conditions of the atmosphere in which the body is immersed rather than to control its composition because its composition is practically stable and needs no attention while its condition is exceedingly changeable as well as important.

RECIRCULATION OF AIR ADVOCATED.

The ideal ventilation for a school building consists in recirculating and properly conditioning its contained air. The advantages are that the air may be kept under more health giving conditions through more perfect control of air movements, dust, odors, humidity, and also that the financial saving is real.

During the past winter the gymnasiums building of the Y. M. C. A. Training College has been ventilated for weeks at a time by using the same air over and over again. It has been renovated only by natural leakages. This building is a large and modern one including two gymnasiums, laboratories, offices, and class rooms, together with bath, locker and dressing rooms. It is used more completely and continuously than any other gymnasium of which the writer has knowledge. This experiment is peculiarly convincing because of the fact that a person doing vigorous exercise vitiates the air from three to eight times as rapidly as a person does at rest. That is, oxygen is consumed and carbon dioxide, sweat and odors are given off from three to eight times as fast as under ordinary conditions of rest.

Extensive and exact determinations have been made as to these various elements as well as to volume of air moved, humidity, and temperature.

The feelings of the students have been regularly ascertained and their health and working capacity, both mental and physical, as carefully measured as was feasible. The various exercise, dressing, class rooms and offices have shown splendid air conditions whether the test was the feelings of the students, the impressions of visitors fresh from the outside, or actual examinations of the air itself. This building with its ventilation apparatus and practice was erected and is administered under the direction of Dr. James H. McCurdy, who is publishing full reports.

5. *Dust and Microorganisms.* Air taken from out-of-doors is often laden with dust. In cities this is most objectionable because of the character of the dust of the streets. Although the recent work by Chapin has allayed our fears from droplet and dust infection nevertheless air should be as far as possible both dust and germ free. This is best accomplished by recirculation where the air is washed or otherwise cleaned

on each circuit and fresh dust is brought only by the pupils.

The Condition of the Air.

Temperature Humidity and Air Motion are so related that they should be considered together. The value of recirculation is to be found in the superior control which can be secured through it over these three factors and their relations to each other.

So far I have shown that ventilation has but little to do with helping or hindering the gaseous exchanges of the body *i. e.* with respiration. The world has quite largely assumed the contrary and has thought that because respiration involved air movements in and out of the lungs and ventilation involved air movement in and out of rooms that therefore ventilation was to aid respiration and the factors involved were the same in both cases—namely the composition of air. Hence ventilation investigations have concerned themselves mainly with a study of such composition. Lately, however, owing to the work of Flugge, Hill, Atwater, Benedict and others we see that *the ill effects of badly ventilated rooms are usually to be found related to body heat and the vasomotor system and that hence the primary purpose of ventilation is to aid in the proper control of body heat.*

Temperature, humidity and motion of air are for this reason matters of primary importance. It is also necessary to consider them together for in this respect they mutually condition each other. Into the complexities of the subject we cannot enter but simply note a few facts.

The hotter the air the less is the body able to rid itself of heat. The colder the air the more heat it abstracts from the body. But—as air becomes heated its capacity for water greatly increases, hence it will the more readily absorb water from any available source. This is the reason why taking air from out of doors, heating it gives us the characteristic hot dry air of the class room. The body evaporates rapidly into this hot dry air—this evaporation has a vigorous cooling effect. This is the reason why a hot dry day is not so exhausting (heat accumulating) as a hot moist day.

A cold damp day seems colder than a cold dry day because the body loses heat to the moisture.

For these reasons a room at 68° F. with ordinary out-door humidity may feel as warm as a dry room at 75° F.—and far more comfortable, for in the latter case the body is rapidly being sucked of its moisture.

Motion of air still further adds to the complexities of the subject. A person sitting in a closed non-ventilated room will very soon have about himself a slowly changing layer of air which his body has warmed. On very hot days his breath may not even rise but staying on a level with his head may aggravate the difficulty. Thus there is formed an "aerial blanket" of hot moist air covering him. The real temperature under such conditions is the temperature of the blanket not that of the room. The reason for the cooling effect of a wind or an automobile ride is to be found in the rapid removal of the air from next to the body.

With a low out-door temperature we have by means of furnaces increased the heat to about 70° F. and then sent it to our class rooms. This air while adequately moist at 10° F. is now drier than the Desert of Sahara. It abstracts moisture from the skin of the body as well as the mucous membranes of nose, throat, mouth and air passages of the children thus cooling them off. To keep the children warm under these conditions of excessive dryness the air must be much hotter than it otherwise should be, hot enough in most cases to flush the skin and produce the symptoms of ill ventilation. A great error is made on the side of over heating—this at first seems a lesser evil than under heating. This overheated excessively dry air is forced through modern school buildings at the rate of 3,000 cu. ft. per person per hour and then is forced out, carrying with it the moisture that has been absorbed from the occupants.

Recirculation largely does away with this great problem of humidity because there is no great raising of the temperature, the humidity varying much as it does under out-of-door conditions.

Thus by recirculation it is more pos-

sible to adequately control temperature humidity and motion of air in their relation to each other and so to the heat control of the body.

The ordinary signs of ill ventilation namely, flushed skin, dull headache, perspiration, somnolence, mind wandering, restlessness, are not found where the air is cool, humid, in pleasant motion and free from odors and dust. These conditions are most readily and constantly secured by recirculation.

The subject of Recirculation in relation to *Economy* belongs for discussion to others than hygienists, hence needs only mention here. The main source of the economy is found in the fact that in recirculating the air it is not necessary to heat large quantities of cold air—It is merely necessary to replace the heat lost in transit. This economy shows in several places:

1. In the saving in coal.
2. In saving in the price of heating apparatus—So large an apparatus is not needed.
3. Probably also a saving in cost of operation.

It is of great promise when the hygienists can propose a step in advance from the standpoint of a health which at the same time commends itself to those responsible for finances as a wholesome economy. Such steps both advantageous and economical will be adopted as soon as it is evident that the results are real. The most difficult problems in ventilation come before us who are interested in school matters for we have the following combination of difficult conditions to meet—

1. Five or more hours of consecutive occupancy per day.
2. Many persons in limited areas.
3. We are dealing with those who are growing and who therefore need hygienic conditions most of all.

These principles will find even more general and satisfactory application to offices, dwellings, factories, etc., and will make good ventilation a rather readily attained result.

Baldwin on Chimneys

WITH NEW CHARTS, FOR USE IN CONNECTION WITH HOUSE HEATING AND POWER PLANTS.

By WILLIAM J. BALDWIN.

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There are many empirical rules and many scientific formulas for proportioning chimneys for boilers. The oldest rough rule that I remember is the one used during the Civil War and known as Bourne's Rule. It was to make "the chimney area one-eighth the grate area" and for the practice of the day it was fairly reliable, as 50 to 60 feet was an average height, unless for large factories.

It is an old English rule and when many of us had to pass an examination in engineering in those days, we studied "Bourne," a writer of the period before the Civil War. He "boiled it down" for the engineer and was very practical. Nearly every engineer in the volunteer service of the United States Navy had a copy of his book.

As long as the grate area was ample the chimney generally proved sufficient, but when one had to work the other way —"having a chimney, to find the grate area"—there were many blunders.

Bourne's practice was with soft coal and chimneys rarely over 60 ft. high,—factory chimneys of his day. His rule may be followed by the steam heating engineer in private house practice, with anthracite coal, without any serious error. In fact, when we consider all the conditions of house-heating practice, height of houses, area of grate in heating boilers, rate of combustion, etc., we find he was not far from being right; perhaps a little on the safe side and that is what we require.

Mr. Robert Briggs, the man who gave the formula for American practice in pipe threads, and whose name it bears, had a habit of saying: "Why live on the edge of a catastrophe?" meaning that

the factor for safety should be large, sufficient to prevent us from falling over the edge.

In designing anything connected with engineering and with a heating apparatus in particular we should keep away from the "danger point." Our chimney should be ample beyond question; our grate area and boiler a little greater than absolutely necessary; our radiating surface ample for the coldest weather and our distributing pipes and mains so large in diameter that they may border on the unnecessary. Almost any kind of a pipe system for a steam heating apparatus will do if the pipe diameters are sufficiently great.

What we nearly all desire to know, however, is "when we are ample," and to determine the point beyond which it would be wasteful to go.

We also want to be able to determine the utmost we can get out of anything and when we are able to determine these two points, we can determine both edges of our path and travel near the center.

TWO LIMITATIONS IN CHIMNEY DESIGN.

In chimney making we have two limitations. (1) HEIGHT AND TEMPERATURE, which determines *intensity*, and (2) AREA, which determines *quantity*.

Intensity we must have to force the air through the bed of fuel and overcome the friction of the crooks and turns of our boiler and the chokes of draft doors, dampers and the elbows of smoke flues and chimney.

Quantity we must have also, or we cannot burn sufficient fuel.

In a sense *intensity* may compensate for lack of *quantity* in a chimney; but quantity will never become intensity.

The intensity can be increased by the increase of temperature of a chimney up to about 600° F., but beyond this there is no gain in quantity, and there will be a loss; as the increased velocity will not compensate for the decreased density of the gas, so that less air will pass the chimney rather than more.

Intensity, so far as the water gauge is concerned, will increase but efficiency will decrease, for the reason that the line of the increase of *intensity* crosses the line of the decrease in density, and we will get less air instead of more air passing through the chimney.

Intensity also varies directly as the height of the chimney; and *quantity* increases or decreases about as the area of the passages.

Therefore, height, temperature and area are the factors that determine the efficiency of the chimney.

FLUES LEADING TO CHIMNEY.

The flue leading to the chimney is always a factor against the chimney and never should have a smaller area than the chimney; unless the chimney is in excess. The length of the flue is always a factor against the chimney and a single right angle or square elbow in the flue exerts an evil influence equal to a length of about sixty-four diameters of the flue, so that all elbows should have rounded backs of as long radius as possible or at least rounded backs.

When the radius of the elbow becomes five diameters of the pipe, the friction or resistance due to the turn is becoming negligible, but when the radius shortens the resistance increases very rapidly; roughly as the inverse of the cube of the radius; so that a great gain is made if the radius of a bend is only 1½ or 2 diameters and nicely rounded compared with a square elbow.

The workman and not the mathematician is the one interested, and it is for him I write. He may verify my assertions by a more extended study of the subject. The point I desire to make is that there is a short way of determining the limit of a chimney, based on scientific rules, by which, if he will commit to memory, he can always determine the utmost value of any chimney, for which he is at liberty to assume conditions.

This utmost limit is all the chimney is capable of doing and beyond which he (the engineer) cannot hope to go and in practice he cannot attain. Determining this limit, therefore, he can discount it and be always in a position to say with confidence, the chimney *is* ample or it *is not* ample.

HOW TO DETERMINE THE LIMIT OF A CHIMNEY.

Air expands as its temperature increases and exactly as its temperature

increases for all practical purposes, if we measure temperature on what is called the absolute scale. To do this add 460° F. to the ordinary air temperature (Fahrenheit). In other words, with the surrounding air at 70° F., we have 70° plus 460° equals 530° on the absolute scale.

If, then, the air of the chimney is heated to 600° F., it would be 600° plus 460° equals 1,060° on the absolute scale, and, as 1,060° on the absolute scale is twice 530° on the absolute scale, the volume in one case would be twice that in the other, or air at 600° F. has twice the volume of air at 70° F. and will fill a chimney twice as high.

In other words, if we had a chimney 100 ft. high, filled with air at 70° F., and warmed the air to 600° F., a column of air at the new density would be 200 ft. high, if we could confine it. The excess height would then equal the height of the chimney itself and the theoretical maximum velocity would be equal to the velocity gained by a body falling through this excess height.

This theoretical maximum velocity can never exceed eight times the square root of this excess height, measured in feet. If velocity is measured in feet per second, or, if the chimney were 100 ft. high, the theoretical maximum velocity of the air or gas through the chimney would be eight times the square root of 100, or 8 times 10, which equals 80 ft. per second.

This is simply the law of a body falling, and, when we know the height of the chimney and its temperature, we can establish the greatest possible velocity that can be acquired under such conditions.

This limits the *intensity* of the chim-

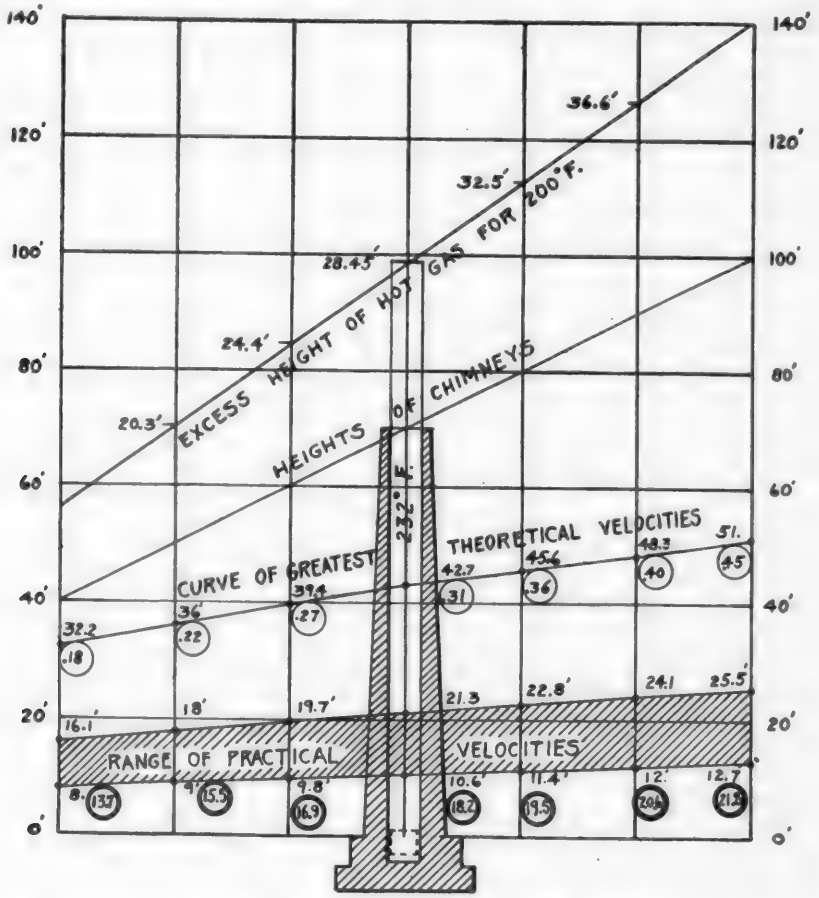


FIG. 1.—DIAGRAM FOR PROPORTIONING HOUSE CHIMNEYS (200° F.).

ney, but this intensity producing velocity is at once disarranged the moment the air or gas begins to move. The friction of the air against the walls of the chimney upsets all this, and must be provided for.

The effectiveness of the chimney, therefore, comes to guessing, unless one has had experience, and the discount may be 50% or 66% or 75%, while the effectiveness, or remaining efficiency ranges from 50% to 25% and between these latter ratios lies the true value of an ordinary chimney.

The beginner hesitates to accept this, but it may be proved by noting the pressure on the water gauge (1) with the damper open and (2) with the damper closed; always measuring the "pull" inside the damper—that is on the chimney side of the damper.

With one's boilers in full operation and all dampers open, and the hot gases passing freely the chimney becomes heated to its working maximum. When the dampers are suddenly closed on such a chimney, the motion of the gases is arrested and the gauge will then show the maximum intensity, modified slightly only by leakage.

When the dampers are opened simultaneously and all the gases that will pass are allowed to escape, then we have the *working intensity* and this multiplied by the quantity gives us the *total efficiency*.

HOW DIAGRAMS WERE CONSTRUCTED.

This working intensity is nearly always to be found varying between 50% and 75% of the total intensity in a good chimney—(one that is reasonably well proportioned to its work), and it is on this practical fact that I take the liberty to construct the diagrams herewith exhibited, one for chimneys up to 100 ft. in height with a temperature of 200° F. (conditions that are likely to be used for heating apparatus) and the second for chimneys of power plants, a height of 75 ft. to 250 ft., with a temperature of 400° F. This covers ordinary conditions of use.

The greater the diameter of a chimney, the less one needs to discount it, as the friction in a chimney follows the same law as the friction in any other pipe.

Reference to the diagrams (Figs. 1 and 2) will show (1) the line indicating the height of the chimney; (2) the excess height of the hot gas; (3) the curve of greatest theoretical velocities; (4) the range of practical velocities, or efficiencies; (5) the expectant water gauge pressures in inches of water, in the single circles; and (6) the safe horsepower per square foot of section of chimney, in the double circles at the bottom.

These are the conditions for a chimney say 12-in. x 12-in., throughout its height; a rectangular chimney in a masonry wall which will be slightly favored in a circular chimney of the same area.

As the chimneys increase in area (cross section) the rule of *the 2.5 power of the diameter* comes into play. So that the efficiencies in round chimneys will increase as the third column while the diameters will increase as the first column; the relative areas being as the *second* column, the gain for the increase of area being the relation between the second and third columns:

Diameter.	Relative areas.	Efficiency.
1	1.00	1
1.5	2.25	2.75
2	4.00	5.657
2.5	6.25	9.88
3	9.00	15.58
4	16.00	32
1	2	3

This will bring the matter so that when a chimney has sixteen times the area it will have 32 times the efficiency or, in other words, it will be twice as efficient per square foot of area as the smaller chimney. This is true if we consider the vertical chimney only, but many other things come in to lessen this, such as the quickened passage of the air through the bed of coal and through the crooked passages of the boiler and its flues and tubes. Therefore, *the truth* is found nearer to the lower line of the shaded portion of the diagram, "range of practical velocities"—though under favorable conditions of boilers, grates, fuels and passages it may reach near the upper line of the shading.

CHIMNEYS MAY BE TOO LARGE.

A chimney may be too large as well as too small. The great oblong-sectioned chimneys of the New York Steam Company's plant in Greenwich Street, New York City, are an example of this. Many of the great power house chimneys are also examples of bad engineering. Had it also increases the internal resistance and less gas will pass the chimney.

Two chimneys should never be connected to one boiler. This is sometimes done in house-heating when one chimney proves to be unequal to the work. Save time by opening the chimney breast and making the two chimneys one.

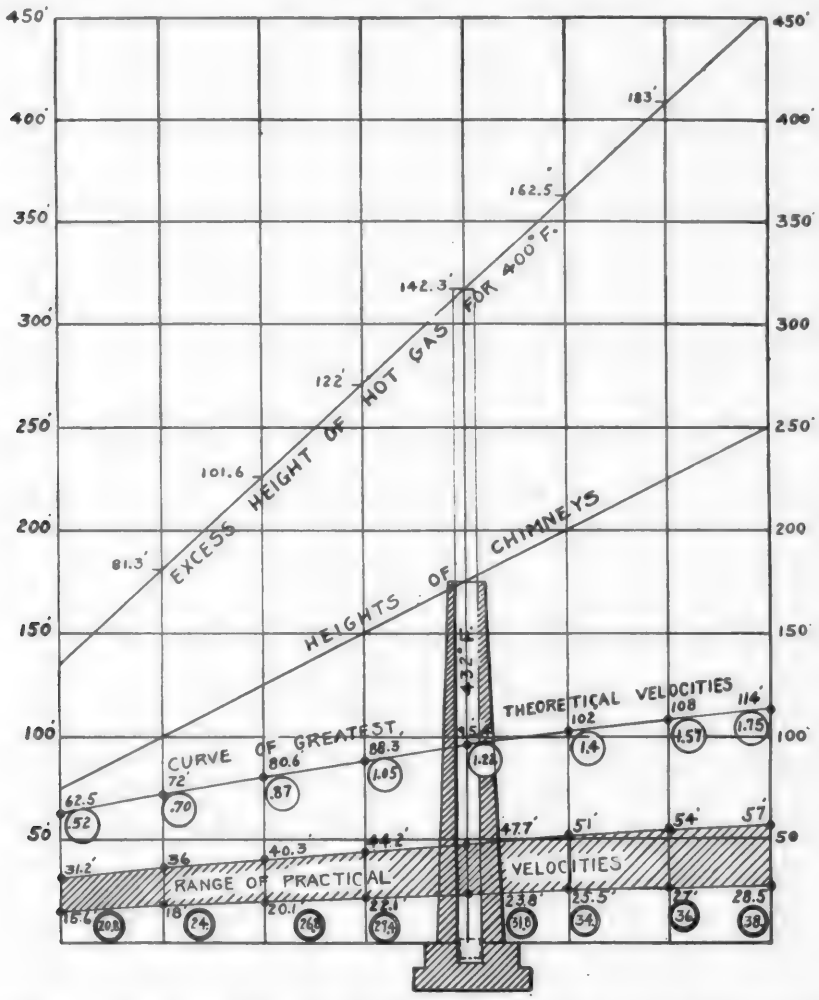


FIG. 2.—DIAGRAM FOR PROPORTIONING POWER HOUSE CHIMNEYS (400° F.).

these chimneys been divided into four compartments, for the usual four sets of flues, generally used they would not drop in intensity, materially, when a partial load was on them.

Chimneys should be parallel their entire length on the inside. There is a loss in a tapered flue. The choke tends to hurry the gas velocity at the choke, but

Neither should two chimneys be connected by any kind of a cross connection to try to make them do the work of a larger chimney. The gas will pass down in one flue and make the value of the other abortive. The favored side will have an upward motion but it will allow the gases to fall down the opposite flue, to supply the favored one and the result

will be *no intensity* in the boiler connection.

This happened some years ago in one of our engineering universities, in the following manner: A new laboratory building and a power house were being built and it appeared a good thing to divide the main chimney—a good masonry stack—into two parts, one part for the boilers and the other for the laboratory hoods.

When the work was completed and the boilers fired there was smoke but no steam. Many efforts failed to produce steam and the boiler contractor failed to get his money, because his boilers "would not make steam." As there seemed to be nothing the matter with the boilers he insisted on his money and it was agreed between the university authorities and the contractor, that they would leave the matter to an outside engineer and be guided by his opinion, as to whether the trouble was with the boilers or the draft and settle accordingly.

A careful examination was begun and everything seemed right. Good boilers according to the specification and an *apparently* good stack. Fire was started, but the smoke drove the firemen from their posts. When possible a small wood fire was started at the base of the stack but this was a disappointment; the draft was not good. Is there a stoppage in the flue, or a mortar board on the top of the chimney, or did some one forget to cut a hole in the coping-stone? No; but an investigation showed that the dividing wall in the stack, between the boiler flue and the flue for the laboratory hoods, had not been carried down to the bottom. It lacked about 4 ft. of the bottom and one cleaning-door had been used for both sides of the stack.

The gentleman representing the university thought that the dividing wall, not being carried down, would not prove sufficient to account for no steam and much smoke, but the dividing wall, which was supported on a lintel, was built to the ground and steam appeared very quickly.

It was found that the air of the laboratory, instead of going up the stack on the laboratory side, would fall down and pass under the setum wall; the little warmth in the boiler side drawing it under the lintel—at low intensity—but still of sufficient intensity to have part of the smoke that escaped up the boiler side of the stack return at the top of the chimney into the laboratory side again. The double chimney proved to be an inverted syphon (see Fig. 3).

The substance of this incident is given to impress it on the mind of a student that double flues will be a failure. The writer has had several experiences in

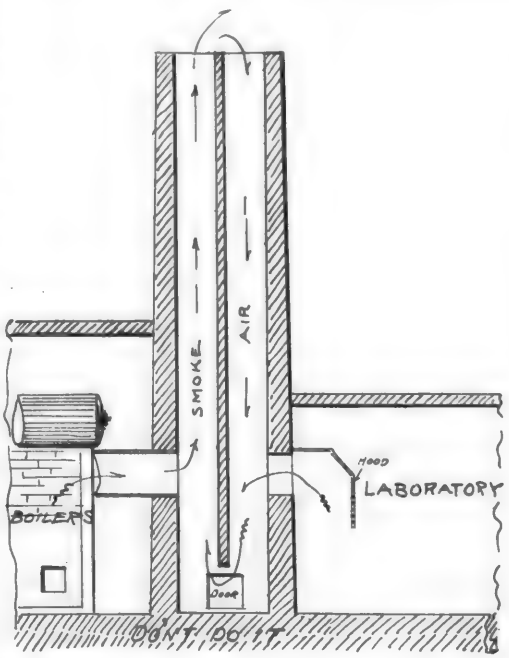


FIG. 3.—EXAMPLE OF INCORRECT CHIMNEY DESIGN.

this line. One was where he found a cast-iron section of a smoke stack within a masonry aspirating shaft had split at the hubs, by the expansion of the rust joints and fallen. The action was similar to that described. The air came down the aspirating shaft and destroyed the intensity in the iron smoke stack and there was no draft.

Air leakage through walls of chimneys should be prevented. It often reaches an amount equal to the difference between success and failure. For a number of years—probably fifteen—the writer has insisted on setting his boilers in cement mortar and in building his chim-

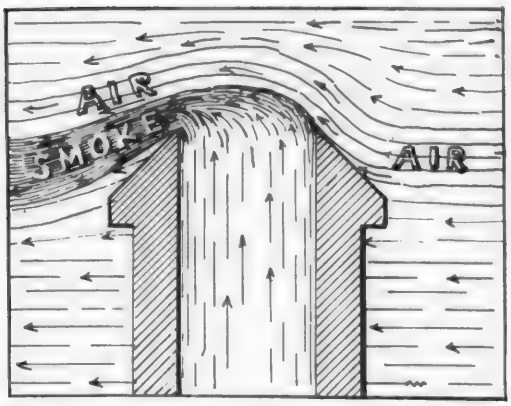


FIG. 4.—APPROXIMATELY WHAT TAKES PLACE AT THE HEAD OF A CHIMNEY ON A WINDY DAY.

neys with cement, when they are outside; one part Portland cement to two parts good sharp sand.

Boilers set this way will withstand the heat better than with lime mortar and they will scarcely show the "expansion crack" near the bridge-wall. A flame of a candle will not draw through the wall nor can a nail be driven into the joints.

Of course, I have nearly always had to overcome the prejudice of the mason in this respect, but the effort will pay.

Contrivances on the top of a chimney to "make draught" seldom or never do so.

The coping or finish on an angle of 45° (Fig. 4) offers probably less resistance to the escape of the gas than any other form of finish and it may under certain intensity of the wind facilitate the draft, but cowls and chimney-tops never do good, except in so far as they may prevent a down draft, or pressure on the top of the flue, when the wind strikes a side wall, or there is a falling eddy.

It is cited that on windy days "the draft is often better." This is generally so, but it is not due to the action of the wind across the head of the chimney. It is more likely due to increased pressure at the ash-pit, the effect of the wind against the walls of the building near the ground, where the free horizontal motion of the air is interfered with, and a pressure results, that "helps the draft from below."

In the matter of the top of a chimney the harder the wind blows the greater the pressure at that point. If we consider a horizontal stratum of air at high velocity passing over the coping of a chimney and another current of air coming out of the chimney at a reduced velocity it is only necessary to carry the matter far enough theoretically to prevent the rising column of air from escaping at all, and if it were not for the intensity within the chimney, there would be a retrograde motion; such as would take place at a large tee with a smaller branch, in which the superior velocity through the large pipe might overcome the velocity through the smaller one and might even turn it backwards.

In the case of the air moving above the top of the chimney it is not confined and can bend away from the upward current. Anything that will favor this bending, such as the 45° chimney top or beveled coping will help this deflection.

This is illustrated by Fig. 4. The sloping-top helps the horizontal air current to deflect upwards and probably the 45° angle is the most favorable—though some think a more abrupt angle would still favor the air deflection, particularly in a high wind.

The illustration (Fig. 4) shows what takes place in a high wind, at the top of the chimney. It will be seen at the tops of the smoke stacks in a high wind and is frequently observed at sea. The smoke bends away and nearly always downwards, unless the air is light; when it rises in a gentle curve and does not fall again until the smoke cools to the air temperature. Then its greater density—

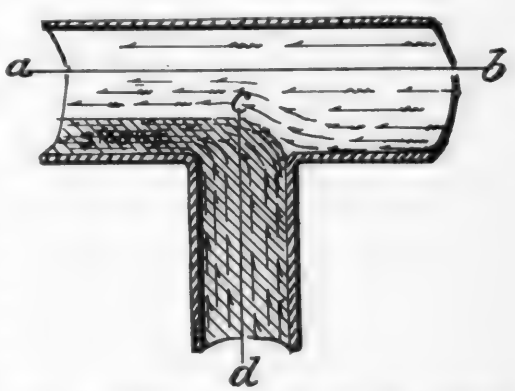


FIG. 5.—EFFECT OF COVER OR CROSS-PIECE ON CHIMNEY.

at the same temperatures—causes it to fall and dissipate.

Under ordinary light winds, the smoke will rise through the air, *first* because of its lesser density, while it is hot and, *second,* because of its impetuosity at the top, unless it is overmastered by the horizontal air current.

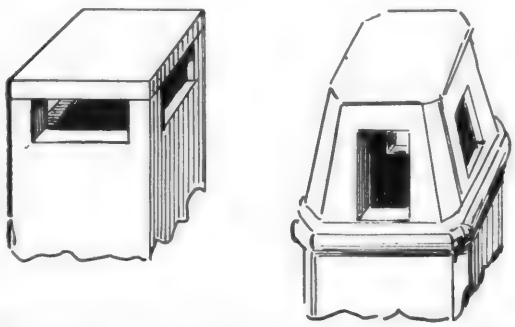


FIG. 6.—TYPICAL FORMS OF CHIMNEY COPINGS THAT ARE SIMPLY CHOKES.

Fig. 5 shows the effect of any kind of a cover or crosspiece on a chimney. The cover or cross-piece acts as an elbow and has a deterrent effect on the escaping gases, the same as any short elbow, and in the case of a *cross-tee* it has the cross-pressure, which further tends to hold the gas down. It can have no excuse in its favor.

Such decorative contrivances as we see on church chimneys and fancy chimney-pots or louvres, never help the draft. The only good they can do is to prevent rain or snow from getting into the chimney or ventilator head and now and then they may be necessities for this or similar purposes only.

A rain or snow screen should be placed as far above the chimney head as possible. Arranging it dead flat on the underside gives the best result.

Referring to Fig. 5 it is only necessary to have the velocity, a-b, sufficiently great (with its attendant pressure) to overcome the pressure, c-d, with its attendant velocity.

The type of chimney head so often seen and shown in Fig. 6 is very much to be guarded against. They are simply chokes, and, unless the chimney is exceedingly vigorous, will always cause trouble. They are a good form of chimney top to be avoided.

Ozone in Ventilation

1—Early Views and Experiments.

By Milton W. Franklin.

(*Read at the Fourth International Congress on School Hygiene, Buffalo, N. Y., August* 25-30, 1913.)

Early conceptions of atmospheric impurity included the belief that carbon dioxide was poisonous and that its existence in the atmosphere rendered the latter unsuitable for breathing. Later, with the growth of chemical knowledge, the conviction grew that so inert and stable a gas, practically incapable of forming chemical combinations, could scarcely prove poisonous to the animal economy. Coincidentally there developed the opinion that the evil effects of air vitiated by the various processes of vital and industrial activity were due to the presence of organic poisons. This belief gradually expanded to include bacteria and the products of their activities. It was supposed that "Besides carbonic acid, expired air contains various substances which may be spoken of as impurities, many of an unknown nature, and all in small amounts."

More recently the opinion has gained ground that there is nothing poisonous in expired air, but that all evil effects might be charged to the presence of moisture and heat.

"Owing to the unpleasant effects often produced in badly-ventilated rooms it was long supposed that some poisonous volatile organic matter is also given off in the breath. Careful investigation has shown that this is not the case. The unpleasant effects are partly due to heat and moisture and partly to odors which are not of a respiratory origin."

Throughout all this evolution of opinion, and even now, there has existed the belief that insufficient oxygen is at the root of all evils arising from inadequate ventilation.

We will now consider briefly the status of each of these views:

That carbonic gas is not poisonous has been amply substantiated, for air in which the content thereof has been artificially increased to 1%, with the corresponding diminution of oxygen, is not harmful, while air in which the carbon dioxide content has been raised to 1% by breathing, is highly poisonous. According to Haldane the effect of 1% of carbon dioxide in the inspired air is so slight as to be negligible.

For the belief that expired air contains organic matters there appears to be some foundation, as *e. g.* the unavoidable evidence of foul breath. The odors arising in crowded and insufficiently ventilated enclosures give evidence of organic contents, though these may not all be expired from the lungs. "The nose may detect what the analytical methods of the chemist fail to show."

The perspiration contains about 2% of solids and much of this is of highly organic structure and presumably easily decomposed. Sweat contains salts, chiefly sodium chloride and organic waste products. Of the organic solids excreted from this source, urea forms the most important under normal conditions. Under pathological conditions, especially when there is interference with free renal action, the amount of nitrogenous waste excluded may become quite important.

HISTORY OF EXPERIMENTS IN CONNECTION WITH EXPIRED AIR.

The history of experimentation with the analysis of expired air is interesting. Hammond, in 1863, concluded that there were organic poisons in expired air. He confined a mouse under a bell jar absorbing the CO_2 with baryta water and the moisture by calcium chloride with the result that the mouse died after 40 minutes.

Brown-Sequord, in 1889, experimenting with mice proved to his satisfaction the existence of organic poisons in expired air. Subsequently, Haldane and Smith repeated these experiments with negative results.

In 1892 Merkel, again repeated these experiments and confirmed the results of Brown-Sequord. Various experiments conducted by Lehman and Jessen, Rauer, Luebbert, and Peters, and others, from 1890 to 1893 were productive of negative results with regard to the existence of organic matter in the expired breath. Brown-Sequord confirmed his previous experiences by an elaborate repetition of them in 1894.

Billings, Mitchell and Bergey were appointed by the Smithsonian Institute in 1895 to conduct experiments for the purpose of settling the question. In a monograph published by the Smithsonian Institute they stated that the ill effects of vitiated atmosphere depend almost entirely upon increased temperature and moisture, and not upon an excess of carbon dioxide, bacteria or organic poisons; the existence of the latter being vigorously denied. In addition to excessive temperature and moisture, odors arising from the subject in various ways, bad breath, unclean skin, unclean clothes, sweat and enteric gases are credited with causing very disagreeable sensation amounting even to nausea in the unhabituated.

Benedict has kept persons in his calorimeter breathing and rebreathing the same air with a CO_2 content as high as 2% for 24 hours without discomfort, the only precaution being to keep the temperature down and to remove the moisture. It is noted that in these experiments some of the air was passed over lime and sulphuric acid every two hours and the greater part of the moisture was removed by condensation, which may also remove other substances than carbonic acid and moisture.

Thus far the predonderance of evidence seems to be against the existence of organic poisons in the expired breath. Quite recently, however, the contrary opinion has been revived by the original and brilliant researches of Rosenau and Amoss. Applying the principle of anaphylaxis on guinea pigs with the clear fluid condensed from expired breath, they have proven the existence of organic matter therein.

"This organic matter must, according to the interpretation of our knowledge of anaphylaxis in the guinea pig, be

protein in nature." They further add "The logical conclusions from our results are that protein substance, under certain circumstances, may be volatile." Weisman and Bronfenbremer recently have disputed these results.

Further evidence contributing to the proof of the existence of organic matter in expired breath has been obtained by Weichardt & Stötter who passed the air expired by guinea pigs and air from a crowded theatre over glycerole, and obtained an alteration in the guiacum reaction.

AERIAL TRANSMISSION OF INFECTION NO LONGER MAINTAINED.

The opinion, once almost universal, that aerial transmission was the chief mode of infection of zymotic diseases has ben largely modified in recent times. One of the most notable protagonists of the view was Dr. Edward Germano.

Bailey speaking of tuberculosis says "This is a disease in which the germs from the dry sputa are carried in the air, lodged in the air passages, and if they find the system in the right condition, they commence to grow and carry on their deadly work."

Credence in the belief of aerial infection, however, has been losing ground steadily, until it has become almost dispelled. Chapin maintains that while it is not possible at present to state with exactness the part played by aerial infection in the transmission of different infectious diseases, we are, by the evidence, forced to the conclusion that the current ideas in regard to the importance of infection by air, are unwarranted. It may be fairly affirmed that there is no evidence that aerial infection is an appreciable factor in the maintenance of our most common contagious diseases. We are warranted, then, in discarding it as a working hypothesis and in devoting our chief attention to the prevention of contact infection. Contact infection with carriers and missed cases affords a better explanation than air transmission for obscure cases of infection. Scarlet fever and diphtheria may be cared for in the same ward if infection by contact be avoided and cleanliness observed. Most diseases are not dust borne, they may be spray borne by coughing, etc., but this is equivalent to contact infection. Tuberculosis is most apt to be air borne, but even this has never been substantiated by pathology.

Flügge, Esmarch, Goldie, Frankel, Moller, Hubner and others have shown that droplets may be found for nine meters in front and two meters behind a person coughing. Winslow and Robinson, by elaborate droplet experiments, show that there is no basis for the belief that tuberculosis or any disease is contracted to an appreciable extent through inspired air, and they are in harmony with the conviction that aerial infection of any sort is a minor factor in the spread of zymotic disease.

Doty states that "The necessity for disinfection is confined chiefly to infected discharges and articles about the patient that may be directly contaminated. Room disinfection is an important factor in the prevention of infection. We have conclusive proof that many of our former theories regarding the transmission of infectious diseases are wrong."

There is a growing belief that scientific proof that infection may be transmitted for a considerable distance by the air, is wanting. In all probability infection by air does not occur except in the immediate vicinity of the patient and then only in a few diseases. This, however, as pointed out above, is tantamount to contact infection, but, in any event, whatever danger there may be is most menacing in closely crowded places where missed cases are always likely to be present.

An interesting aspect of the subject is presented by Trillat, who has demonstrated that microbic life is very sensitive to even slight chemical changes in the air. Alkaline gases like NH_3 and amines from fecal matter, etc., favor the development of typhoid bacillus and other microorganisms.

The view that the ill effects of vitiated air are due only to excessive heat and moisture is widely advocated. Haldane, Billings, Mitchell and Bergey, Flügge, Baruch, Formanek and others have arrived at this opinion from experiments.

Respecting the influence of lack of oxygen in ventilation, there is very little difference of opinion. The constitution of air is as follows:

	Atmospheric air, Per Cent.	Expired air, Per Cent.
Oxygen	20.93	17.0
Nitrogen	79.04	79.04
CO_2	0.03	0.03

Thus the oxygen is diminished approximately 4%, and only 19%, or less than one-fifth of that taken into the lungs is utilized. Flügge, Hill and others have demonstrated in numerous experiments that diminution of oxygen to the extent met with under the worst conditions is not inimical to health. At an altitude of 10,000 ft. the density of the air becomes two-thirds that at the sea level, and the oxygen content of a lungful is accordingly lessened one-third, but compensation in the shape of increased lung capacity and accelerated respiration soon overcomes the distress at first experienced.

IMPORTANCE OF OFFENSIVE ODORS AS CONTAMINATING FACTORS OF AIR.

As contaminating factors of air, offensive odors have not been afforded due prominence. The fact that crowd odors are organic effluvia cannot be disputed. The sensation of smell is due to the presence in the air of substances in a fine state of subdivision; i. e. existing in the state of vapors, or of gases. Ramsey points out that as a general rule substances having a low molecular weight have either no smell or simply cause irritation of the nostrils. He also shows that in the carbon compounds, increase in specific gravity of a gas is associated to a certain point with the sense of smell. McKendrick points out that it would appear that odors of animal effluvia are of higher specific gravity than the air and do not readily diffuse. Such smells are very persistent and difficult to remove, and the presence of moisture increases the perceptibility of odors.

The above facts are significant in connection with the results obtained in rendering stale air more tolerable by keeping it in motion and reducing the moisture, which overcomes their tendency to remain in contact with the subjects and lessen their activity. The sources of crowd odor are the skin, enteric gases, localized excretions, bad teeth and fecal matter, rather than the breath.

Aside from the role of smell as an indicator of organic contamination of air, its physiological effects are distinct. The Smithsonian Report, cited above, gives the smell as one of the paramount causes of discomfort. According to Macfie bad smell may cause nausea or faintness, and Parkes and Kenwood say that odors alone may be prejudicial to good health.

Everyone has noted the distress consequent upon the presence of offensive odors. Frequently when entering tanneries, glue factories or other obnoxious plants for the purpose of making observations, men in my employ have been so disturbed as to have their efficiency appreciably lessened; shallow breathing and anorexia have resulted directly with consequent lowered vitality.

Hill has given considerable publicity to the contention that organic odors are innocuous, and he cites the cases of those engaged in disagreeable trades, and their good health and easy habituation as evidence. This, however, is scarcely a parallel case, as the odor from the trade are not the excreta of the men engaged therein.

A consideration of the above data leads to some interesting conclusions:

(1) Excess of CO_2 does not constitute a danger of vitiated air in ordinary circumstances.

(2) Lack of oxygen is a negligible consideration.

(3) Heat and humidity play an important role in rendering "close" air intolerable.

(4) Organic matter exists in the air of crowded rooms. Its odors constitute a real nuisance, but its toxicity has not been established.

(5) Bacteria in the air, are, at most, a minor factor in the conveyance of infection.

(6) The problems involved are of a complexity which renders their solutions extremely difficult and most of them are still more or less debatable.

DIFFERENCES OF OPINION AS TO STATUS OF OZONE IN VENTILATION.

The first attempts at the employment of ozone as an adjunct in ventilation is perhaps to be ascribed to the fact that ozone had been observed in regions remote from human congestion, where the atmosphere was known to be fresh and invigorating, and to its absence from the air of highly populous districts. In an era of conflicting scientific opinion of questions of disease causation it is not to be wondered at that the mysterious gas, ozone, which was enjoying a vogue among chemical investigators, should have been hailed, in the popular mind, as the philosophers' stone of hygiene. This cult, which occupied the middle and latter third of the last century, gradually evolved into a period of saner search for sound theoretical justification of the empirically demonstrated effectiveness of ozone. At present there still exists much difference of opinion as to the exact status of ozone in ventilation, it being considered, by some, a disinfectant of polluted air, by others, as deodorizer, whilst yet another contingent regard it as an oxidizer of the organic content of vitiated atmosphere.

Experimentation for the purpose of ascertaining the effect of ozone on vitiated air has been varied and exhaustive and it will be necessary to confine ourselves to a consideration of the work of only a few of the more prominent authorities.

Scoutetten demonstrated that ozone removed the odor of heaps of decayed manure, even in the presence of the latter, and that it destroyed the odor which remained after the manure had been removed from the experimental chamber.

According to Schoenbein 1/6000 of ozonized oxygen, containing 60 litres of air, sufficed to disinfect 540 times its volume of air charged with miasms and putrid emanation. M. J. Chapuis demonstrated the microbicidic power of ozone by drawing infected dust into cotton tampons and then disinfecting them by drawing ozonized air through.

In 1892 Dr. Ohlmüller reported that anthrox, typhus and cholera bacilli, as well as anthrox spores are destroyed by ozone. Typhus and cholera bacilli contained in sewage and water of the Spree were destroyed, but ozone apparently has little effect on dry bacteria and bacilli. Two litres of ozonized air killed the bacilli which exist in pus, and living subjects inoculated with such ozonized pus did not suffer any inconvenience. He also pointed out that negative results, in attempting to purify air, remedy unsanitary conditions and disinfect dwellings result from inadequate ozone apparatus.

In the face of many positive findings as to the value of ozone, controversy has been rife up to the present. Konrich admits the efficacy of ozone for water purification, but holds that for ventilation its use is still problematical. He maintains that concentrations sufficient to oxidize suspended organic matter would be detrimental to the living organism, and that the most that ozone can accomplish is to cover up odors. The value of this, he says, is questionable, since it removes the only warning that we possess of the presence of vitiated air. Schneckenberg holds substantially the same view.

Luebbert states that ozone purifies the air and that the existence of even a slight excess of ozone is proof of the non-existence of the organic dust, ill-smelling particles and agents of infection.

Elrandsend and Schwartz assert that there is no justification for the statement of Luebbert. They experimented with a room of about 14.96 cubic meters capacity. The walls were covered with metal plates painted black. They do not definitely state the amount of ozone in the room but the concentration was about 20 to 30 mg. per cubic meter of air. Different gases, fumes, etc., were drawn into the room and mixed with ozonized air. After varying periods of time the mixtures were examined. They conclude that oxidation of NH_3 and H_2S cannot be proven, but that the odors can be removed; trimethylamin, valerianic acid, butyric acid, indol and skatol are not destroyed by obone, but their odor can be disguised; tobacco smoke is not influenced so far as can be determined, but if present in small quantities its odor can be removed; they cannot say that ozone purifies the air, but only that

its intense odor covers or removes other odors.

Kuckuck claims that in the Heidelberg Public Baths he reduced the bacterial content of the air by 50%, by the application of ozone. Kuppfer finds that a concentration of 0.1 mg. ozone per cubic meter of air in bathing establishments has an invigorating and purifying effect. Foreign odors are eliminated and the conditions generally are improved. Bail says that the odor of decaying matter does not recur after having been removed by ozone, and that small ozone concentrations can destroy odiferous elements in the air, therefore ozone can probably destroy the organic impurities in expired air and animal excretions.

WIDE APPLICATION OF OZONE AS ADJUNCT TO VENTILATION.

The most recent pronouncement on the subject has been presented at the Ninth Congress for Heating and Ventilating in June of this year at Cologne Germany, by Prof. Dr. Czaplewski. From an exhaustive series of observations he concludes that there is a wide application of ozone as an adjunct to ventilation. He finds that ozone has a positive effect on certain odiferous materials and odors emitted by these materials; some odors are destroyed and others lessened; other odors are, in part, referred back to odors absorbed by the walls, furniture, etc.; ozonization of the air should not supplant ventilation but used as an accessory; ventilation can, in many cases, be improved by ozone; discrepancy between the favorable results in practice and the unfavorable results of experimentation should be further investigated.

In next month's issue Dr. Franklin will describe the extensive experiments he has been making to determine, among other things, the action of ozone on odors and certain gaseous emanations, such as tobacco smoke, natural food odors, decomposed food odors, definite chemical compounds of disagreeable odors, offensive trade odors, carbon monoxide, also the bacteriacidal action of ozone.

Modern Mechanical Equipment for a Public Institution

HOSPITAL FOR RELIEF OF RUPTURED AND CRIPPLED, NEW YORK CITY.

The new home of the Hospital for the New York Society for the Relief of the Ruptured and Crippled on East Forty-Second Street, is a building of the most modern type of fireproof construction. The two main staircases, located in the east and west ends of the main building, are entirely enclosed and separated from the corridors by fireproof doors. The emergency staircases in the north wings are also enclosed and have an exit, at the second floor, to the roof over the court.

From this roof two fire-escape stairways lead to the street. Passenger elevators (large enough to take stretchers), enclosed, separate from the stairs, serve the two sides of the building and a freight elevator, near the service entrance, runs from the sub-basement to the sixth floor.

The individual floors are used as follows:

Basement Floor.—The service driveway for supplies and for employes enters the northwest court from Forty-third Street. All the supplies for the building are delivered from the trucks at a covered platform the height of a wagon-bed and are dropped to the service yard, on the basement level, on an electric lift. Opening from the yard is a vault for kitchen coal and for the coal used in the forges of the brace shop, and a small autopsy room, lighted overhead, containing two mortuary receptacles. Just inside the basement entrance is the general store room.

HOSPITAL FOR RUPTURED AND CRIPPLED, NEW YORK.

Directly opposite the entrance a special corridor leads to the kitchen on the east court. This room has a tile floor and walls and is equipped with modern cooking apparatus.

Two automatic power dumbwaiters, serving the main pantries, open directly from the kitchen. Adjoining is a refuse room (accessible also from the main basement corridor), where garbage and refuse is discharged into an incinerator in the sub-basement. Opening from the kitchen corridor are the store rooms for dry stores, a cooled vegetable room, a room for dairy products, with its refrigerators for milk, butter and fruit, and a butcher shop with a refrigerator for meat and poultry.

The laundry, in the southwest wing of the basement, is equipped with individual motor-driven apparatus. Besides the usual machines found in the modern laundry, there are two sterilizers which are fed from a room opening on the main corridor near the freight elevator. Infected linen, clothing or mattresses may be brought in bags from the upper floors to this room, the bags removed and the mattresses which require dry sterilization, placed in the Kenyon-Francis sterilizer while the soiled linen, or any article which requires washing at the same time that it is sterilized, may be put in the sterilizing washer. Both these sterilizers are built into the laundry wall so that when the process is completed, everything is removed from the laundry side.

MECHANICAL EQUIPMENT.

There is a complete plant for heating, ventilating, lighting, power and refrigeration in the basement and sub-basement. The ventilation is mainly exhaust with a certain amount of tempered fresh air introduced in all patients' and operating rooms. All the machines in the brace shop, which is on this floor, are of the latest design, and have direct connected motors, thereby doing away with all overheated shafting.

From the westerly entrance on the first floor all dispensary and in-patients pass through a vestibule into a large waiting room, two stories in height. High windows on the north and south give an abundance of light and natural cross ventilation.

The second floor is a low story and is given up entirely to living quarters for the superintendent, staff, matron, housekeeper, graduate nurses, experienced nurses and female help. Each class of emoloyes is in different wings with their corridor cut off from the main halls.

The third floor is devoted to four ward units. Each unit is separated from the main corridor by double doors and consists of a ward, lighted on three sides, planned for 20 or 22 beds; a dressing room with sink, water and instrument sterilizers and a bracket for the harness used in applying plaster jackets; a toilet and bath room sufficiently large for three or four patients to be wheeled in who are in carts or wheel chairs and containing besides the usual fixtures, a marble bathing slab, with sink attached for patients unable to be bathed in the tub; a quiet room for three or four beds and a linen and store closet.

In the center of the main portion of the building on the third floor is a large dining room for the three south wards served by the main pantry and an auxiliary pantry on the opposite side. Both pantries are served from the kitchen by two power dumbwaiters and equipped with steam tables, gas burners, sinks, refrigerators and dressers. The female adult ward in the northeast wing has its special dining room served from the main pantry.

Facing the south are two loggias opening directly from the three south wards. The flat roof over the low northwest wing, accessible from the main corridor, will also be used by the patients. On this floor are closets for portable tubs, slop sinks and a nurses' toilet.

The fourth floor is the same as the third, except that the operating suite takes the place of the ward unit in the northeast wing.

The main operating room is arranged with an amphitheatre seating 50, and with standing room accommodating several more. This is reached by the students and visiting doctors by stairs from the floor above, thus obviating the inconvenience of having visitors in the operating suite. The seats in the galleries are supported on brackets and made of enameled iron modeled somewhat like a bicycle saddle. This seat is not only sanitary but allows a maximum amount of space for passage way. The room is naturally lighted by a north window and skylight in the rear of the amphitheatre constructed of steel and wire glass. Inside the window is a glass screen in a steel frame arranged to prevent a down draft on the patient or on the students. Hot air is introduced between the two sashes. There is an outlet for the X-ray apparatus so that photographs may be taken during operations.

The small pus operating room has a gallery, accessible from the corridor on the floor above, with 14 seats and standing room for 8 or 10 persons. The window in this room is of similar construction to that in the main operating room.

Between the two operating rooms is the preparation and instrument room containing a built-in steel and glass instrument cabinet, a cabinet for supplies, a water sterilizer and a sink. This sink, as well as those in the operating rooms, is supplied with sterile water with elbow faucets, while the filtered water has the foot control.

The sterilizing room, connecting directly with the main operating room, is equipped with water, dressing, utensils and two instrument sterilizers, one for each operating room. The floors and walls of the operating, sterilizing and instrument rooms are of tile.

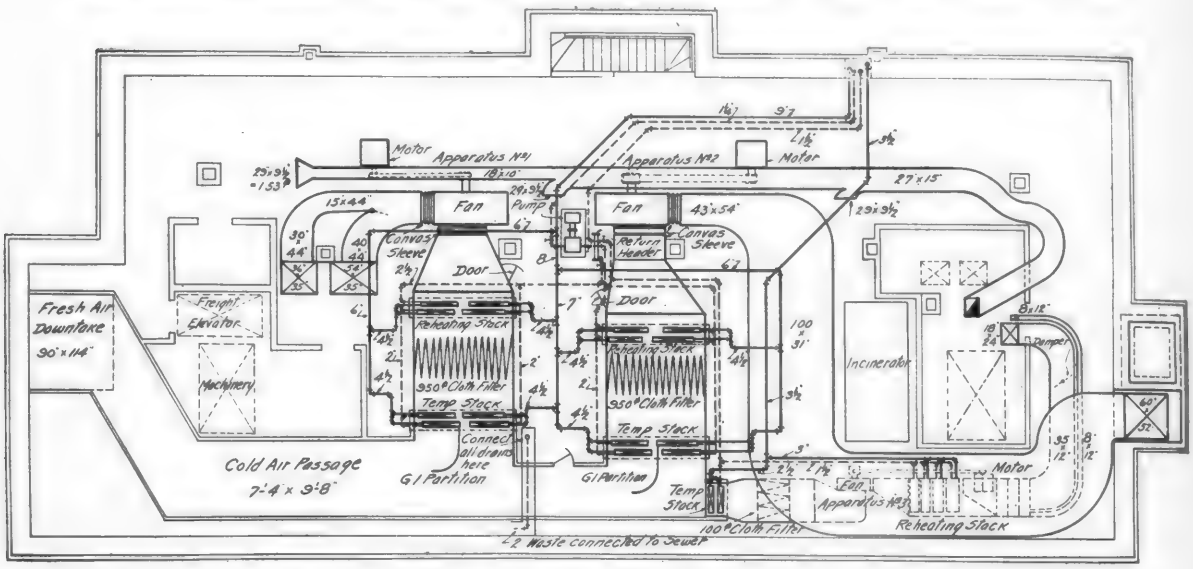
The large room on the fifth floor with the crossed vaulted ceiling is known as the assembly and play hall. Here all the children who are able to attend school assemble for the morning exercises after which the pupils in the upper grades go to the four class rooms on the easterly side of this floor. The large room is also used by the kindergarten, for serving the mid-day meal to all the school children, for a play-room in the afternoon and for special entertainments.

A large portion of the sixth floor is planned with a flat roof for out-door treatment and recreation. The solarium

divides this into two sections, one for the boys and the other for the girls. A large part of each section is roofed over so that patients may be out even in the most stormy weather. As the view in all directions is most attractive the masonry parapet is kept low and a wire mesh screen built above it for protection. Meals may be served on the roof from the pantries on this floor.

The solarium is so planned with its dependences that in the event of a contagious disease breaking out in the hospital it may be used as a contagious ward and isolated entirely from the rest of the building. Opening directly from it is a dressing and a toilet and bath room, provided with a sterilizing hopper and lighted overhead. Off a special corridor is a linen closet, sterilizing room and two bedrooms with bath between and dining room for nurses; the latter room being served by a special pantry.

In the towers and roof space above this floor are the house tanks, fans for exhaust ventilation, and the overhead elevator machinery.



SUB-BASEMENT PLAN OF HEATING AND VENTILATING APPARATUS, HOSPITAL FOR RUPTURED AND CRIPPLED.

Steam Supply.

The steam supply is furnished by four Fitzgibbon's compact vertical marine type boilers designed for a working steam pressure of 120 lbs. The length of these boilers over all is about 17 ft., and the height about 11 ft., and the width 6 ft. 7 in. Each boiler contains approximately 1,750 sq. ft. of heating surface and about 26 sq. ft. of grate surface.

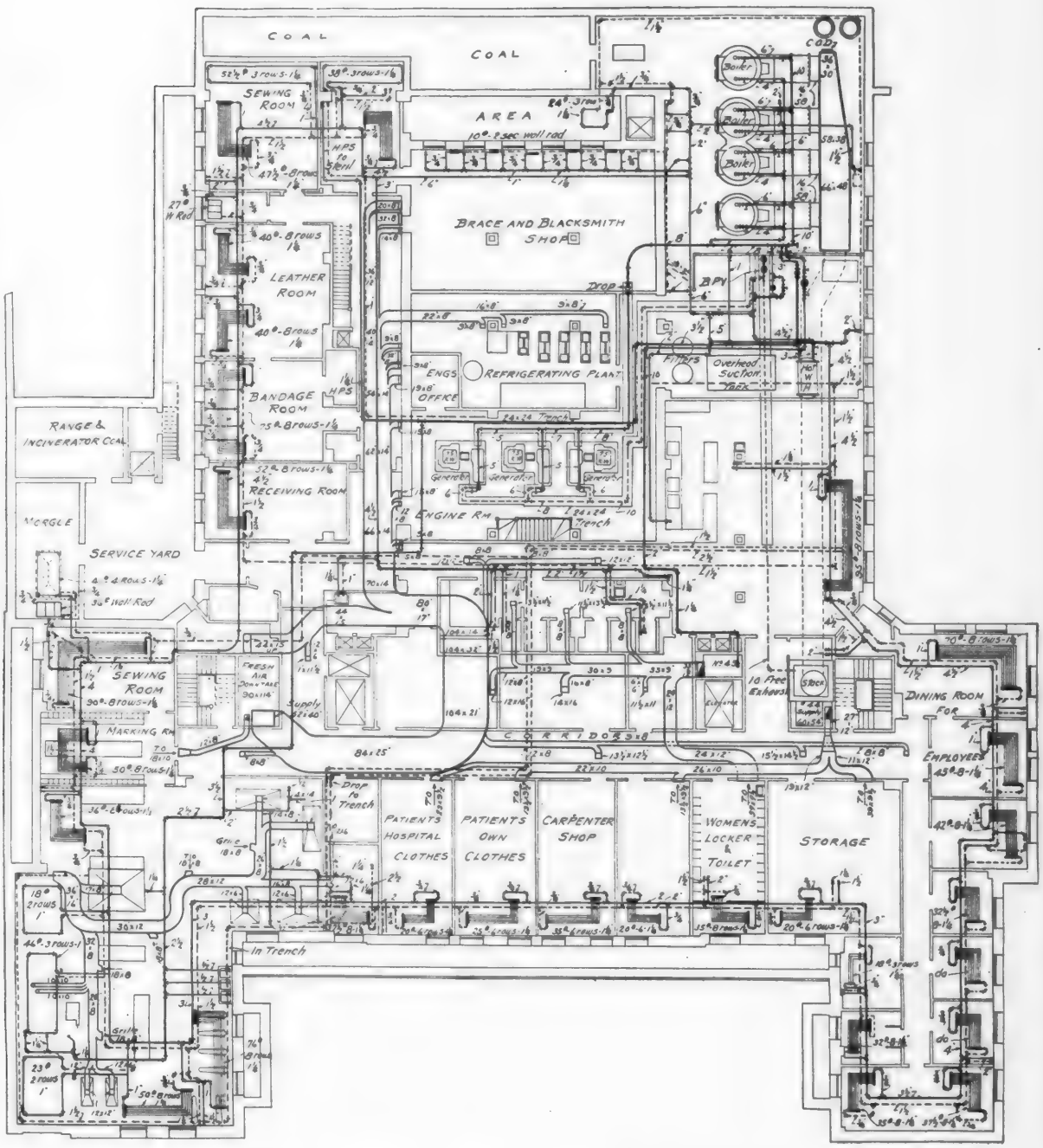
Connected to each boiler with special connecting collars 14 in. by 28 in. of 3/16 in. iron is a turbine fan of 200 H.P. capacity with a 1 in. supply connection and 1½ exhaust.

These boilers are set on concrete footings 20 in. deep and 9 ft. 2 in. square with ash pits dished down 16 in. below the floor level.

A "Venturi" feed water meter is installed for obtaining the amount of feed water and a 2½-in. double filtration multiple cartridge type feed water filter of 700 H. P. capacity is also provided.

Hot Water Service Tanks.

Two hot water service tanks are installed, containing steam coils with *thermostatic* regulation and a gate valve on the steam connection and a gate and motor seal valve on the return. The hot water regulator has a regulating diaphragm valve in the steam pipe and thermostat in the hot water tanks located approximately 1/3 up from the bottom. A feed water heater is installed of 1,000 H. P. capacity, being 4 ft. 6 in. x 4 ft. 6 in. x 7 ft. 6 in. high. The boiler feed pumps are two 2 1/3 x 5 x 6 in.

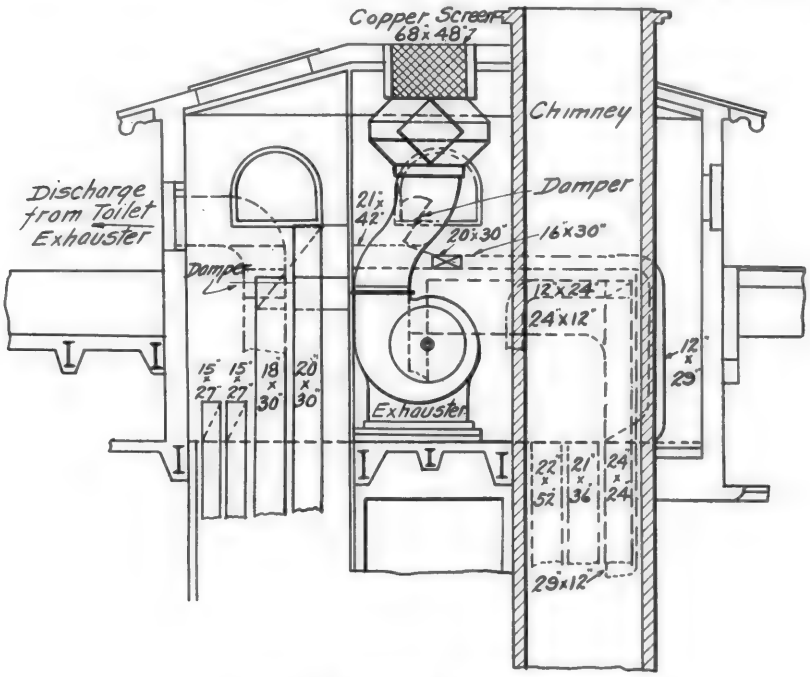


PLAN OF BASEMENT, HOSPITAL FOR RUPTURED AND CRIPPLED, NEW YORK. SHOWING HEATING AND VENTILATING SYSTEM.

Duplex piston pumps, brass fitted, and the vacuum pumps are two 8 in. x 12 in. x 12 in. brass-lined vacuum pumps for very hot water, fitted with suction strainers.

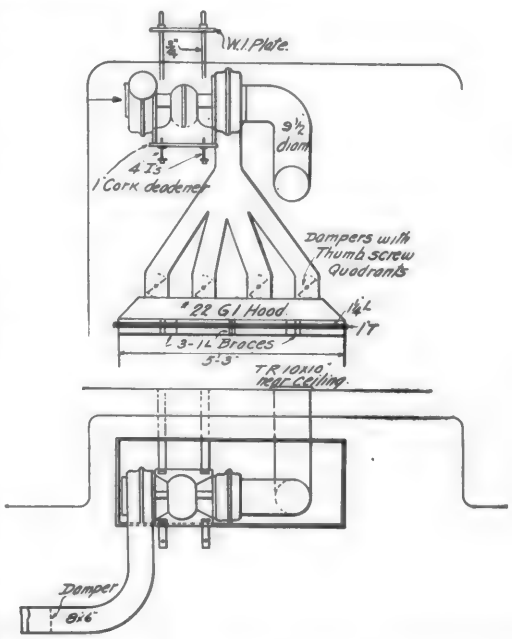
and a 3½ in. vapor pipe run up through the roof.

On each engine is installed a vertical, down current pattern, steam separator with a water glass and a 1-in. drip con-



TOILET ROOM EXHAUSTER.

There is also a fire pump with hose valves, Underwriters water relief valve which is cross connected to the house pump; the house pump is of 7½ x 5 x 6 cold water pump with cold water valve. In the sub-basement are located two rotary hot water pumps to lift the condensation from the Vento coils into the feed water heater. The condensation from the Vento heaters flows by gravity into a receiver consisting of a piece of 6 in. pipe 3 ft. long and capped on each end with 1½ in. vapor pipe run from the top to the vacuum return header in the pump room. The condensation flows by gravity from this receiver to the pump. These rotary pumps are 3 in. x 4 in. x 1¼ in. type F, 3 lobe pumps with a displacement of .07 gal. per revolution. Direct connected to each pump is a 220-volt, direct current electric motor connected through a flexible coupling. The blowoff tanks is 36 in. x 48 in. of cast iron with a 4 in. connection to the sump tank



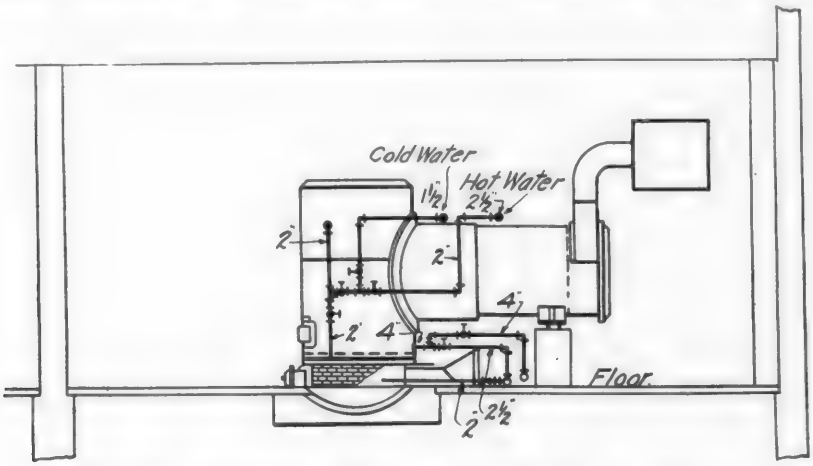
DETAIL OF VENTILATING EQUIPMENT FOR DARK ROOM.

nection through 1½-in. trap to the receiver. In the sump well is placed a No. 3 Yoemans electric driven sump well pump with a capacity of 150 gallons per minute under operating conditions. This pump is driven by a 220-volt, 3-H. P., direct-current, vertical shaft motor with automatic control. From the pump a 4-in. discharge line is run to the outlet left in the drainage system in the boiler room where it is connected through a check and gate valve. The air separating tank is 30 in. high and 7 ft. long, made of 3/16 in. iron with a 3-in. vapor connection to the vapor pipe to the blow-off tank.

In the suction pipe from the vacuum return header to the vacuum pumps is installed a condenser of a capacity for 50,000 sq. ft. of direct radiation, having a 3-in. flanged inlet and outlet. The cold water connection to the hot water generator is taken through this condenser.

Radiators.

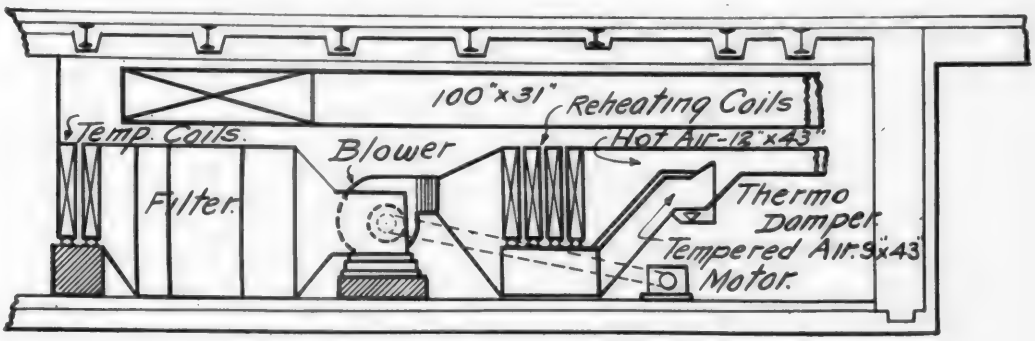
The direct radiators in general are similar to the Peerless plain pattern hot water hospital style, and are hung 3 in. from the wall. The wall radiators are erected with the usual hooks and are finished to match the finish of the rooms.



SECTION SHOWING WATER CONNECTIONS TO BOILERS.

The pipe coils on the walls and ceiling are of straight lengths of pipe connected by branch tees and fittings.

Each radiator coil or heater, excepting those automatically controlled, has on its supply connection, which is made at the top of the radiator, a graduating control valve and every radiator, coil heater and Vento stack and the hot water heater has on its return connection, a water seal combination, air and water relief float valve. The pressure reducing valves are of the low pressure lever pattern flanged, and with bypasses, and the back pressure valve has a lever and



APPARATUS FOR AIR SUPPLY TO OPERATING ROOMS.

graduated weights to maintain any pressure up to 4 lbs.

On the connections to the fan heater each section is separately valved on both the steam and return connections so as to allow the use of as many sections as desired. A complete system of mains is provided with a kitchen and pantry and another separate system for the laundries and sterilizers and also for the hot water heaters in the refrigerating plant, all of which are kept separate from the heating system, and are so valved as to be operated independently.

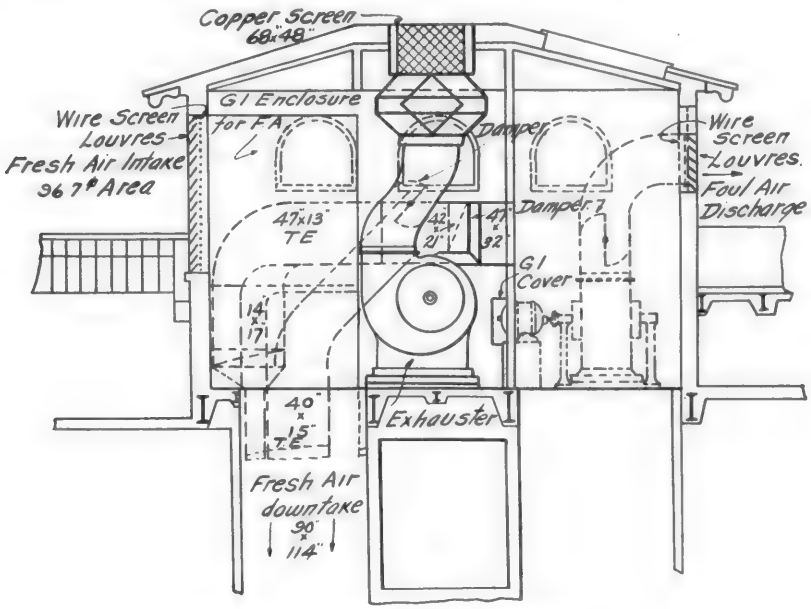
Steam connection with a gate valve and connection with a gate and check valve is made to the steam table in each pantry and to the sterilizing hopper in room No. 618 from the laundry system.

Automatic Control.

A steam or automatic temperature regulation is installed in connection with this heating plant, consisting of 10 duct thermostats in the sub-basement, two hot water thermostats in the basement, 15 thermostats controlling 45 radiators on the first floor, 12 thermostats controlling 43 radiators on the third floor and 13 thermostats controlling 32 radiators, one mixing damper, two shift dampers, one controlling mixing damper, also two three-way valves operating 4 radiators. On the fifth floor are 12 thermostats controlling 38 radiators, and on the sixth floor, 2 thermostats controlling 13 radiators.

Indirect Heating.

There are a total of 11 fans installed to operate the indirect heating and the exhaust systems. These are all motor-driven, being connected by flexible couplings. The Vento heaters consist of 3 separate heaters: No. 1 consisting of an 8 group with 12 sections per group, and a heating surface of 1,032 sq. ft. for the tempering coil and a similar coil for the reheater, each with 301 sq. ft. of heating surface for the re-heaters. The second apparatus consists of tempering and reheating coils similar to the first, of heating surface for the tempering coil and a similar coil for the re-heater. The third apparatus consists of 2 groups of 7 sections, each with a total of 150 sq. ft. of heating surface for the tempering coils and a similar coil for the re-heater. These heaters are all of the cast iron Vento type, each group being separately valved on both the steam and return connections.



FRESH AIR FAN AND EXHAUSTER.

The fan inlets and outlets are con-

nected to the ducts by 10-oz. double canvas sleeves 8 in. long.

Diffusers and deflectors are liberally used especially back of the outlet and inlet openings near the grille and register faces.

The radiators are the American Radiator Company's Peerless. Pipe covering was furnished by the H. W. Johns-Manville Co., and the thermostatic control by the Johnson Service Co. The ventilating fans are of the American Blower Company make. Gillis & Geoghan, New York, were the heating contractors.

The architects are Messrs York & Sawyer, of New York, and the engineers, R. D. Kimball & Co., of New York and Boston.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Meeting of Heating Engineers' Society to Amend Charter.

At a meeting of the American Society of Heating and Ventilating Engineers, held in New York, September 29, it was voted to amend the charter by increasing the number of directors from seven to twelve. At the same time, several amendments to the constitution were proposed, all of which will be sent to the members in the near future for a mail ballot.

At a meeting of the council held at the same place earlier in the day, it was decided to hold the annual meeting of the society in New York, Tuesday, Wednesday and Thursday of the third week in January, 1914.

Progress in Drafting Model Compulsory Ventilation Law.

Chairman J. D. Hoffman of the Committee on Legislation for Compulsory Ventilation, in a circular letter to members of the society, states that his committee expects to have a formal draft of a model heating and ventilation law in shape for presentation at the coming annual meeting of the society. In an effort to obtain the final consensus of opinion on the verbiage of the proposed bill, Chairman Hoffman asks for specific answers to eighteen questions covering disputed features of such a law.

Officers Nominated for New York Chapter.

The following nominations have been made for officers of the New York Chapter for the ensuing year, the election taking place at the October meeting of the chapter:

For president, D. D. Kimball; for vice-president, J. I. Lyle; for secretary, Wallace Goodnow; for treasurer, Arthur Ritter; for members of council, Frank G. McCann, Walter S. Timmis and W. H. Driscoll.

Ontario Society of Heating and Ventilating Engineers.

A new organization of heating and ventilating engineers, made up principally of Canadians, has recently been formed in Toronto. While not directly affiliated with the American society, its officers are also members of the American body. For the present the headquarters of the Ontario society will be in Toronto. Following are the officers appointed for the ensuing year:

President, George Huey.
Vice-president, M. F. Thomas.
Treasurer, R. B. Mackinnon.
Secretary, Norman A. Hill.

CHARTER MEMBERS.

R. B. Mackinnon, Pease Foundry Co., Ltd.
M. F. Thomas.
Norman A. Mill, manager Industrial Buildings, Ltd.
A. S. Leitch, Sheldon's, Ltd.
E. Q. Cole, Williams & Cole.
George Huey, Canadian Domestic Engineering Co., Ltd.
Holt Gurney, Gurney Foundry Co., Ltd.
E. Schofield, Pease Foundry Co., Ltd.
W. P. Crawford, A. B. Ormsby Co., Ltd.
R. L. Smallwood, Canadian Buffalo Forge Co.
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C. B. Richardson, Keith's Ltd.
A. J. Dickey, C. A. Dunham Co.
H. H. Angus, Canadian Domestic Engineering Co., Ltd.
C. M. Sparling, Bennett & Wright's, Ltd.
R. T. Waterman, H. G. Waterman & Co.
C. T. Morse, Canadian Sirocco Co.
Wm. Mansell, Purdy, Mansell Co..
R. F. McHenry, W. J. McGuire Co., Ltd.
Richard Dawson, Darling Bros.
C. F. Doughty, Board of Education, Toronto.
A. E. Freeman, consulting engineer, Manning Chambers.
R. E. Winn, General Manufacturers' Agency, Ltd.
F. C. Dairs, engineer, General Fire Extinguisher Co.

HONORARY MEMBER.

Prof. C. H. Wright, University of Toronto.

American Society of Mechanical Engineers.

The annual meeting of The American Society of Mechanical Engineers will be held in New York, December 2-5, 1913.

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A. S. ARMAGNAC.....*President*
GUSTAVE PETERSEN.....*Secretary and Treasurer*

A. S. ARMAGNAC, Editor
GUSTAVE PETERSEN, Business Manager

European Representative:
W. G. HOLLINWORTH, 304 High Holborn
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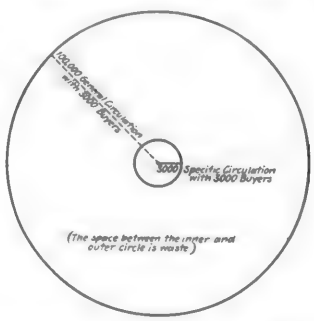
Foreign countries, - -	1.50 " "
Back numbers, - - -	15 cents a copy

WE TRUST we shall be pardoned for talking this month more particularly about ourselves. We take considerable pride in the fact that this issue of THE HEATING AND VENTILATING MAGAZINE enjoys the largest advertising patronage of any number we have issued. While such an achievement is always a source of gratification as marking a further step in advance, in this case we feel it is a distinct tribute to the value of quality, as distinguished from quantity, circulation. It has long been our boast that the specialized trade journal, with its comprehensive circulation, is in a better position to serve both reader and advertiser alike than the more general trade paper.

This brings to mind the statement made in an address on "Quality Circulation" before the Federation of Trade Press Associations in New York last month (which is really responsible for the present discourse about ourselves) to the effect that "more important than the question of how many people the paper reaches is, first, what is the buying power of these people and, second, what is the influence of the paper with them? The impression which an advertisement makes upon a reader is influ-


100,000 General Circulation with 3000 Buyers
3000 Specific Circulation with 3000 Buyers
(The space between the inner and outer circle is waste.)

enced largely by the impression which the publication has made on that same reader. The publication introduces the advertiser and in an introduction much depends upon the intermediary."

"Quality circulation," added the speaker, "cannot be solicited—it must be built. There is no way to send out clever circulation men or devise an attraction for business men who will constitute quality circulation."

How this applies to the advertiser is also shown by the statement that "the advertiser who buys circulation alone should employ his workmen by size regardless of skill, should hire his lawyers on price regardless of knowledge, and should purchase his medicine by the gallon regardless of ingredients."

Since its establishment, THE HEATING AND VENTILATING MAGAZINE has followed the important policy of sticking to its own field. While such a policy always has its disadvantages in circumscribing a journal's activities, these are more than counterbalanced by the class of readers it attracts and the attention it is able to devote to that field. This was demonstrated in a convincing manner by several of the speakers at the recent trade press convention and is now given further confirmation in our own case by the success that is attending this policy.

THE CONSULTING ENGINEER

"The Consulting Engineer" is prepared to reply, in this department, to any questions which our readers may ask regarding problems connected with the design and installation of mechanical equipments of buildings.

20.—Efficiency of Heat Transmitting Apparatus.

QUESTION: Assuming that a pound of coal contains 12,000 B.T.U., in ordinary heating practice, with pipes covered, what percentage of these heat units will be delivered from the radiator into the room?

ANSWER: The B. T. U. obtained from a pound of fuel in a boiler depend on the square feet of heating surface and the amount of water evaporated from and at 212° F. in proportion to the coal burned. The greater the heating surface between the grate of a given size and the flue, the greater the evaporation. When the boiler is forced, the flue gases go out hotter, reducing the efficiency.

The square feet of heating surface per unit of work have more to do with the efficiency of the boiler than the type, other things being equal. In the cast-iron boiler business the square feet of heating surface is not catalogued by the makers, except in one instance, so it is almost impossible to compare the different makes, as far as the actual size of the boiler one is getting is concerned.

The evaporation may range from 6 to 10 lbs. of water per pound of fuel burned from and at 212° F., or 970 B. T. U. per pound. If the covering were 85% efficient, and there were 12,000 B. T. U. per pound of fuel, the total efficiency in each case would be as follows:

$$\frac{8 \text{ lbs.} \times 970}{12{,}000} = \frac{7{,}760}{12{,}000} = 68.66\% \times 85\% = 58.36\%$$

$$= 7{,}003 \text{ B. T. U.}$$

$$\frac{9 \text{ lbs.} \times 970}{12{,}000} = \frac{8{,}730}{12{,}000} = 72.75 \times 85 = 61.84 \times$$

$$12{,}000 = 7{,}421 \text{ B. T. U.}$$

$$\frac{10 \text{ lbs.} \times 970}{12{,}000} = \frac{9{,}700}{12{,}000} = 80.835 \times 85 = 68.71 \times$$

$$12{,}000 = 8{,}245 \text{ B. T. U.}$$

$$\frac{11 \text{ lbs.} \times 907}{12{,}000} = \frac{10{,}670}{12{,}000} = 88.9 \times 85 = 75.56 \times$$

$$12{,}000 = 9{,}067.20 \text{ B. T. U.}$$

The above results depend entirely on the square feet of heating surface or size of boiler in proportion to the work to be done, a good chimney and a good draft being understood. These quantities give about the limits of good practice.

Regulation of Steam Heating Corporations in the State of New York.

The Legislature of the State of New York has, by a statute passed during the session of 1913, which went into effect May 8, 1913, brought steam plants within the State under the jurisdiction of the Public Service Commission. The term "steam plants" is defined to include all real estate, fixtures and personal property used in the generation, transmission, sale or furnishing of steam for heat or power. A "steam corporation" includes all corporations and individuals owning, operating or managing any steam plant, except where steam is produced by the maker on his own property for his own use or that of his tenant, and not for sale. Following is a summary of the new article of the Public Service Commission Law dealing with the subject.

§79. *Adequate service; just and reasonable charges; unjust discrimination and unreasonable preferences.*—1. Every steam corporation must furnish safe and adequate and just and reasonable service, at just and reasonable charges, not exceeding those allowed by the commission having jurisdiction.

2. Special rates, rebates, drawbacks, or other such devices are prohibited except as authorized by the statute.

3. Undue or unreasonable preferences or advantages to any person, corporation or locality are prohibited, and also all unreasonable prejudices or disadvantages.

4. Sliding scales for a fixed period for the automatic adjustment of charges and dividends may be established, provided they are filed with and approved by the proper commission; but after the expiration of such period the commission may fix proper, just and reasonable charges for service.

§80. *General Powers of Commissions as to*

Steam Heating.—Each commission shall within its jurisdicton:

1. Have general supervision of all steam corporations having statutory authority to lay down pipes in the streets, etc., for furnishing steam for heat and power, and of their plants.

2. Investigate their methods and order reasonable improvements and extensions.

3. Prescribe uniform methods of keeping accounts, records and books, and forms therefor. Six months' notice of any alteration in such methods or forms to be given to the companies.

4. Have access for examination of the methods, regulations, and property employed to all steam plants, through the members or employees of the commission. It is made a misdemeanor for an employee or agent of the commission to divulge any fact or information which may come to his knowledge during such inspection, except as directed by the commission or other lawful authority. If the commission is of opinion that the rates or charges or the acts or regulations of any person or corporation are unjust, unreasonable, unjustly discriminatory or unduly preferential or violative of the law, it shall prescribe just and reasonable rates and charges, and acts and regulations. If any property, equipment or appliances are found to be unsafe, inefficient or inadequate, it shall prescribe safe, efficient and adequate property, etc.

5. Require an annual report, verified by the oath of an officer of the company. The report must show in detail:

(a) The amount of its authorized capital stock and the amount thereof issued and outstanding; (b) the amount of its authorized bonded indebtedness and the amount of its bonds and other forms of evidence of indebtedness issued and outstanding; (c) its receipts and expenditures during the preceding year; (d) the amount paid as dividends upon its stock and as interest upon its bond; (e) the name of its officers and the aggregate amount paid as salaries to them and the amount paid as wages to its employees; (f) the location of its plant or plants and system, with a full description of its property and franchises, stating in detail how each franchise stated to be owned was acquired; (g) such other facts pertaining to the operation and maintenance of the plant and system, and the affairs of such person or corporation as may be required by the commission. The form of the report is to be prescribed by the commission. A penalty of $100 a day for failure to file the report within the time to be prescribed by the commission is imposed, which time the commission may extend for cause shown.

6. Have power by its members or inspectors to enter upon and inspect the companies' properties.

7. Have power to examine all the books and papers of the companies and prescribe the keeping of particular accounts.

8. Have power to compel, by duces tecum, the production of all books and papers or sworn copies thereof, and to require specific answers to questions upon which the commission needs information under a penalty of $100 a day for failure to obey.

9. Have power to subpoena witnesses in any proceeding or examination instituted by the commission.

10. Have power to require every steam corporation, person or municipality to file with the commission and to print and keep open to public inspection schedules showing all rates and charges, forms of contract and rules and regulations relating to rates, charges or service, and all general privileges and facilities granted by them; but this subdivision not to apply to state, municipal or federal contracts. No change to be made in any rate, charge or service filed without thirty days' notice to the commission and publication for thirty days, unless allowed by the commission on cause shown.

11. Steam corporations engaged in any other business not under the jurisdiction of the commission are not required to report as to such other business. But the commission may inquire into the apportionment of the capitalization, earnings, debts and expenses between the two businesses. If the steam plant is wholly subsidiary and incidental to the other business and is inconsiderable in amount and not general in its character, the commission may, by general rules, exempt the corporation from making full reports and from the keeping of accounts in regard thereto.

§81. *Approval of Incorporation and Franchises; Certificates.*— The approval of the commission of each district in which any part of the work of constructon of a steam plant is to be performed must be obtained before it is begun. New franchises and franchises which have been suspended for more than a year must be approved by the commission. A certified copy of the corporation's charter must be filed, and the required consent of the municipal authorities shown. Municipalities must have a certificate of authority from the commission before establishing plants for supplying steam.

§82. *Approval of Issue of Stock, Bonds and Other Forms of Indebtedness.*—Provision is made for the issue of stock, bonds, or other evidence of indebtedness for the acquisition of property, the construction, completion, extension or improvement of a corporation's plant or distributing system, or for the improvement or maintenance of its service, or for the discharge or lawful refunding of its obligations or for the reimbursement of moneys actually expended from income or an order authorizing such issue.

§82a. *Reorganization.*—1. Reorganization of steam corporations is subject to the supervision and control of the proper commission.

2. Upon such reorganization the amount of capitalization is as authorized by the commission.

§83. *Approval of Transfer of Franchise.*—All transfers or leases of franchises, works or systems or parts thereof must have the assent of the proper commission. The acquisition of the stock or bonds of any other steam heating corporation is placed within the control of the commission.

§84. *Complaints as to Service and Price of Steam Heat; Investigation by Commission; Forms of Complaints.*—Provision is made for the investigation by the proper commission of complaints by municipal authorities and private consumers as to the price, pressure or efficiency of steam supplied. Forms of complaints are to be prescribed by the commission.

§85. *Notice and Hearing; Order Fixing Price of Steam or Requiring Improvement.*—Notice of the complaint and investigation is provided for and for the decision of the commission thereon.

§86. *Penalty for Non-compliance with Order.*—The penalty for non-compliance with any order of the commission is $1,000 for each offense.

§87. *Proceedings for Violations.*—Provision is made for proceedings by mandamus or injunction in case of violation of an order.

§88. *Defense in Case of Excessive Charges for Steam Heat.*—No recovery can be had for excessive charges for steam heat.

§89. *Powers of Local Officers.*—Local boards possessing the necessary jurisdiction are given power to enforce the state laws and the orders of the commission.

§89a. The term "proper commission" in the article means the commission of the district within which the whole or the greater part of the service is rendered by the person or corporation affected.

ELBERT HUBBARD ON TRADE PAPERS.

2.

(This series of articles commenced in the September, 1913, issue.)

The successful man is the observant man. He is the man who possesses the fine art of eliminating the superstitious, unauthoritative, the worthless; of sifting in his cosmic ash-can the false and the true and eliminating the waste, the burnt-out bosh and bull-conish bombast.

The successful man, the rubber stamper of the times, maintains a checking account in his own psychic first-national.

With the unfailing constancy of a perpetual motion machine, he deposits new things there, on interest. And he is no glutton either. He loves not the golden doubloon of knowledge for its own sweet self alone. He loves it because he is in the game. He is the modern business man or craftsman. He is ever circulating his fund. He applies it as it applies to his calling.

Observation is merely the ability to utilize your divine lamps to good advantage. First you must see, then you feel, then you know. Informed men are those who can work intelligently. And it makes little difference how many eyes you've got either. A certain railroad genius can see more with one star-gazer than most folks can with two.

If the latest isn't out yet—keep a weather eye peeled on your trade journal, my hearty!

We grow as we do. We become by doing things—not folks.

The wrong way now may have been the right way then—infinite past.

And so we ingrow. If you are aware of anything worse here upon this blessed globe than a bandanna, amorphous-souled, Burbank-cactus backed, bazazza-ed, backsliding William Angora—retrogressive, what-was-good-for-Da-da-s-ditto-for-me, vimless, dummy firecracker, sawdust-filled blank cartridge of a human jelly-fish—kindly step up on the platform and whisper in my ear.

He is the kind that does not read the journal in his own field. He synchronizes past and present. And his desert is what he deserves—oblivion.

We must give and sweat, in order to live and get! Reciprocity! We receive comeasurably with what we give. But you must have something to give. Mere willingness and right intent is not enough. You are being paid not only for what you can do but for what you actually do—for results.

If one is ever going to amount to any-

thing in his own line he must be able to do a thing better than the other fellow. Otherwise obsolescence for his—down in the muck and mire with the rest of the groundlings.

To give or not to give—to be or not to be—aye, that is the question. If you agree accordingly, our panacea, of "Be Up-To-Date! Know!—Know! Know!" becomes operative, practical.

The man who knows is the man who goes—up in the world of dollars and sense and in the estimation of others and in his own.

He reads his specialized journal—

Trade journals are the heralds of industry and prosperity. They are the radicals in the convention of progress. They are experimenters, builders, systematizers, organizers, pioneers, in their own particular fields—

They are the consecrators and conservators. They are the cats that pull the chestnuts out of the fire—for our delectation.

They are the courts of last conjecture. They know! It is their business to know—that is why they exist. And we learn all we know from them. For journals are nothing but crystallized fact—predigested food of experience. And experience is the universal educator.

Trade, class and technical journals make it a business to tell the truth. They do not deal in hearsay, rumor, misinformation or hypocrisy. Life is too short, and they know it. They taboo the nebulous. They omit the intangible. They venture to verify and verily—they do.

They give a man courage, animation, ambition. They are not published for mummies.

If you would know of the new wrinkles in your business or profession; if you would know how other folks are progressing, thinking, what methods they employ to achieve their ends—and how to improve your condition and position—if you would converse with the men who are headliners in your field, who have already made good but who are still discontented, still striving, hoping, aspiring to greater things and who have worked out their own salvation—if you would continue to be such a man yourself—read your specialized journal!

Get out and meet the world. Absorb animation, amity, animal-heat, love of work, charitableness, vim, vigor and vitality. Resolve to do, or die doing. Absorb, like a lusty bull calf, from that big, blessed, beneficent enterprise—The Trade Journal.

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New Standard for Flanged Fittings.

A new standard for flanged fittings, for standard and extra heavy pressures, which is known as the (new) American Standard, was adopted, September 17, by the Committee of Manufacturers on Standardization of Fittings and Valves. The schedule becomes effective January 1, 1914.

The American Standard marks the latest effort on the part of the manufacturers to reconcile the differences that exist between their schedule and the schedule adopted by the mechanical engineers' society and by the master steam fitters' association.

In speaking of the "1912 U. S. Standard," which is the title of the schedule adopted by the societies named, the circular states that "the adoption of this standard opened a discussion among those interested in the subject. It was found that the dimensions presented in the 1912 U. S. Standard differed from the dimensions which had been quite universally used by manufacturers and which covered a large majority of the fittings made. At a meeting of manufacturers, held in New York City, July, 1912, a standard known as the Manufacturers' Standard was adopted by them. This left the flange fitting subject in the unfortunate position of there being two standards. When this condition came before the committee of the American Society of Mechanical Engineers, an effort was made by this committee with that of the manufacturers' committee, to harmonize, if possible, the differences then existing between these two standards. After considering the various phases of the subject covering uniformity of design, strength of fitting, strength of bolting, as well as the commercial features, a compromise was made. In this compromise the bolting was increased where it was thought necessary. Additional size flanges were added, and the center to face and face to face dimensions were altered to conform to these requirements."

The same circular contains the new schedule in detail with explanatory notes, and no doubt copies may be obtained by addressing the Committee of Manufacturers on Standardization of Fittings and Valves, 30 Church St., New York.

The attitude of the American Society of Mechanical Engineers towards the compromise effected is shown by the statement in the September issue of the Journal, as follows:

"The Committee on Flanges and Flanged Fittings has been in conference with manufacturers of valves and fittings with a view to finding some ground on which manufac-

turers who have large commercial interests and a great deal of money tied up in patterns and castings can come together with a committee desiring to attain a standard to insure the greatest possible safety through a consistent proportioning of the various sizes of flanges and fittings. The situation in this regard was fully outlined in the Journal for August, 1912. The changes from previous practice recommended by the committee referred mainly to heavy work and to sizes above 9 inches, where the main considerations are those of safety, and no expense should be considered too great to secure immunity from accident. Their recommendations were such as to secure a reasonable factor of safety throughout the whole range of sizes and a uniformity of dimensions providing for interchangeability of fittings.

"Manufacturers at that time were beginning to supply material according to the 1912 U. S. Standard of Flanges and Flanged Fittings recommended jointly by the committee of this society and that of the National Association of Master Steam and Hot Water Fitters, but a number of them announced that an extra charge would be made where a compliance with the standard necessitated a material change in the existing patterns.

"As a result of the conferences our committee has been holding, a tentative schedule has been agreed upon which only awaits formal acceptance by the manufacturers and by the society.

"The new standard fully covers all considerations of safety, but it has not been found expedient to maintain the feature of interchangeability."

The Theatre Ventilation Situation in Chicago.

The moving picture theatre ventilation ordinance in Chicago is still the subject of animated discussion on the part of those interested or affected by the measure. The latest information is that the theatre owners are preparing to introduce a new ventilation ordinance which would materially modify the present requirements. This is in accord with the statement of Health Commissioner Young that he has information that an assessment of $25.00 has been levied on each member of the Motion Picture Exhibitors' League for the purpose of fighting the ordinance. In this way it is estimated that the fund will easily reach $10,000.

In the meantime, effective publicity of the health department's efforts to see that the "movies" are properly ventilated is being secured through the issuance of special certificates to those theatres whose ventilation equipment complies with the city ordinances. These certificates, which are being placed at the entrance of those playhouses receiving them, read as follows:

"This is to certify that the .... theatre is provided with a system of ventilation which, if operated as it is intended to be, will insure to the patrons the supply of fresh air required by law.

"GEORGE B. YOUNG,
"Commissioner of Health."

By this method of creating "certified" theatres, the health department hopes to encourage the public to seek out those in which the air is good.

In speaking of recent tests for bacteria in ventilated and unventilated theatres, Dr. Young states that, roughly speaking, the tests show that the chances of picking up bacterial infection is fifty times greater in the unventilated than in the ventilated show places. He also adds the information that there are 600 "movies" in Chicago, with a seating capacity of about 260,000. The majority of the theatres give three performances daily to an attendance of nearly 500,000, a large percentage of whom are children.

In an address before the Woman's City Club, of Chicago, Dr. Young told the members that the draft of a new ventilation ordinance, drawn up by the moving picture theatre owners, was ready and will soon be presented to the council. Its chief clause will be a diminution of the amount of fresh air required to pass through the theatres, especially in old buildings, the claim being made that the requirements for such buildings are excessive. On this point, Dr. Young said: "After the law went into effect in 1910 we found it a common practice for the moving picture theatre owners to turn in a set of plans showing proper ventilation facilities, and then to put up the theatre without the ventilating system. We have about stamped out that practice. We are having a hard time, however, to make those theatres made over from stores comply with the ventilation ordinance."

As a result of the agitation on the subject, a committee of women has been appointed by Mrs. Harriet Taylor Treadwell, president of the Political Equality League, to aid Mayor Harrison and Dr. Young in their efforts. Mrs. Edward R. Tyrrell is chairman of the committee, and she outlines the committee's plans as follows:

"We intend to awaken the women to the need of fresh air in the places of amusement where their children spend such a large part of their time. Ward meetings and parlor socials will assist us until we feel that perhaps we can make an open fight on the conditions to which we object.

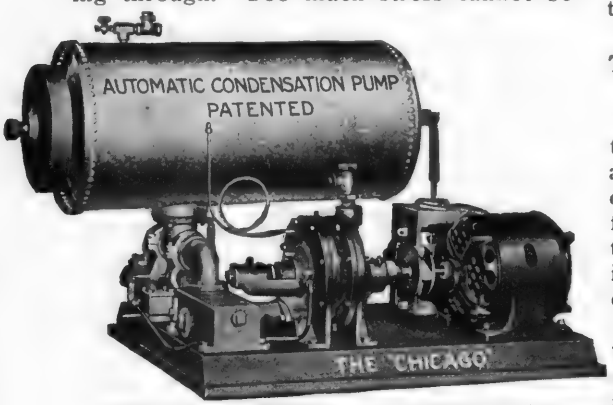
"Personally I feel that the censorship of the five-cent theatre should rest in the hands of women entirely instead of policemen. Policemen are hardened to so many conditions that they often fail to realize the effect which many seemingly harmless films may have on the sensitive mind of a child."

Important Features to Be Looked for in a Condensation Pump and Receiver.

For the benefit of those who are contemplating purchasing a condensation pump, some interesting hints are given by the Chicago Pump Co., of Chicago, which is one of the pioneers in the condensation pump business, and the maker of the Chicago automatic electric condensation pump.

1. Before the condensation returns enter any important part of the machine, it should pass through a settling chamber where the scale and rust that accumulate may be cleaned out.

2. The pump should by no means be so designed that the hot water it pumps should lubricate its bearings, but should have outer board ring oiled bearings on both sides of the pump with shaft extending through. Too much stress cannot be



CHICAGO ELECTRIC CONDENSATION PUMP.

laid on this feature of a condensation pumping outfit or the hot condensation water will heat the bearings before the pump has even started and when the pump is running bearings will become still hotter and expand, frequently sticking the shaft and causing the motor to burn out. This is impossible with the outer board ring oiled bearing pump.

3. By all means avoid the use of float controlled devices as the floats will get fine cracks in them from the great changes in temperature, which will cause the float to become water logged and sink. For this service there is nothing simpler and more reliable than the tilting tank receiver, which has recently been patented by the Chicago Pump Company. This tank avoids the use of the float and its connecting arms and levers. It tilts just enough to close the automatic switch when a certain quantity of water has entered the tank, because it is then much heavier at one end than at the other and is thus compelled by the weight of the water to tilt. When the water has been pumped out, tank will again tilt back into normal position.

4. An automatic boiler feed attachment should be mounted on each condensation pumping outfit, which automatically supplies the necessary amount of water to keep up the supply in the boiler and at the same time prevents steam binding by allowing the cold water to spray into pump. This attachment should have a valve which may be adjusted so that any desired quantity of water may be supplied or it may be shut off entirely if desired, without in any way interfering with the operation of the pump.

5. The automatic switch should be a simple and positive one, as it wlil be remembered that without the proper operation of it, the entire outfit will not work. For this service, a double carbon contact type switch is best adapted.

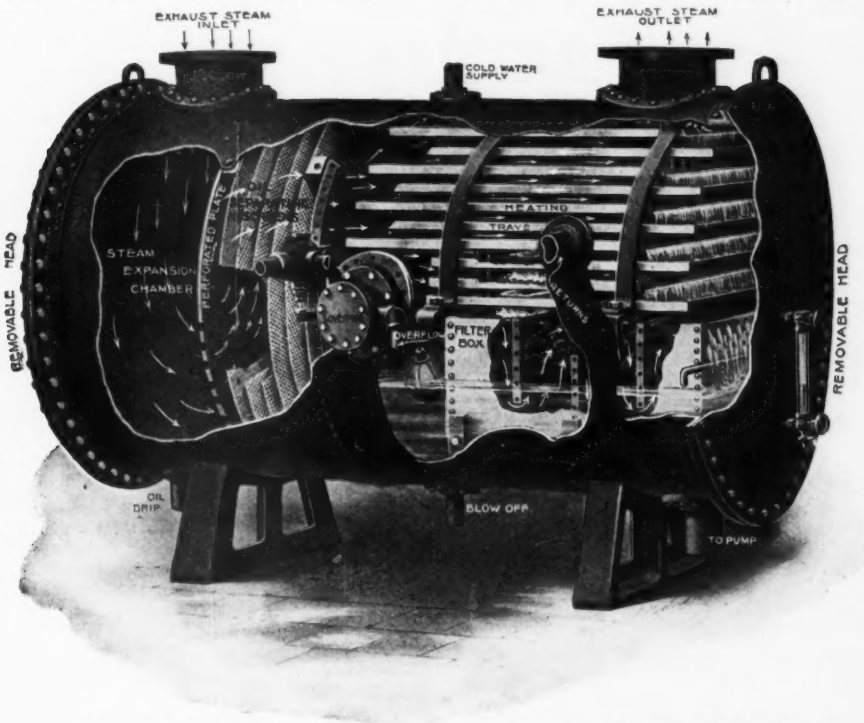
The Linton Steam Separator and Feed Water Heater.

The heating of water is merely the matter of sufficient tube or tray surface, and any feed water heater, providing the amount of surface is correctly figured, will heat the feed water to the highest possible temperature. Higher temperatures can be obtained in an open feed water heater than in a closed heater, for in the open heater steam comes in direct contact with the water which it is heating, and the condensation which takes place thereby is also saved and used for boiler feed.

Exhaust steam from engines, pumps or other sources, of course, contains cylinder oil. This oil, passing through with feed water into the boiler, settles on the tubes and plates. There it collects scale which is baked hard, preventing the water from coming in contact with the metal, resulting in overheated and bulged plates and leaky tubes. Therefore, some satisfactory method of removing this oil before the steam comes in contact with the feed water must be provided.

The Linton separator consists primarily of a large expansion chamber where the velocity of the inrushing steam is greatly reduced and where it is expanded in volume to a ratio of not less than fourteen to one. The steam then passes through the per-

forated baffle plate, which is merely provided to break it up into small parts and not to act as an oil separator for which it has no practical advantages. The steam then passes through a series of especially-constructed wire-mesh separating screens which remove the oil remaining in the steam and not taken out in the expansion chamber. These screens are self-cleaning and do not become gummed up in the operation, so that the Linton separator is declared to be just as efficient ten years after being placed in operation as it is ten days after.



LINTON STEAM SEPARATOR AND FEED WATER HEATER.

The accessibility of this heater is particularly marked, as the removal of a few bolts allows the head to be taken off and the interior reached for cleaning or any purpose. It is claimed to be very simple in operation, requiring no attention and containing no complicated parts or skimmers to get out of order.

Due to its construction it can be operated with steam with considerable back pressure without danger of leaking joints or crecked plates. It is built in capacities of from 100 to 10,000 H.P.

The "Linton Combination" is manufactured by the Linton Machine Co., 26 Cortlandt St., New York; and, in addition to the feed water heater, muffler and steam separator, includes a line of traps and exhaust pipe heads.

American Blower Company Acquires McCreery Engineering Company.

The American Blower Company, of Detroit, Mich., has purchased the entire air washer interests, including patent rights, of the McCreery Engineering Company, formerly of Toledo, O., and later of Detroit, Mich.

The McCreery Company enjoyed a universal reputation as engineers and manufacturers of efficient air purifying apparatus. Their earlier efforts were almost exclusively confined to marine work. Later the company entered the general ventilating field, in which the air purifier now forms an indispensable part of any mechanical ventilating system.

The McCreery purifying, cooling and humidifying equipment will hereafter be exclusiyely manufactured and sold by the American Blower Company under their trade-mark "Sirocco."

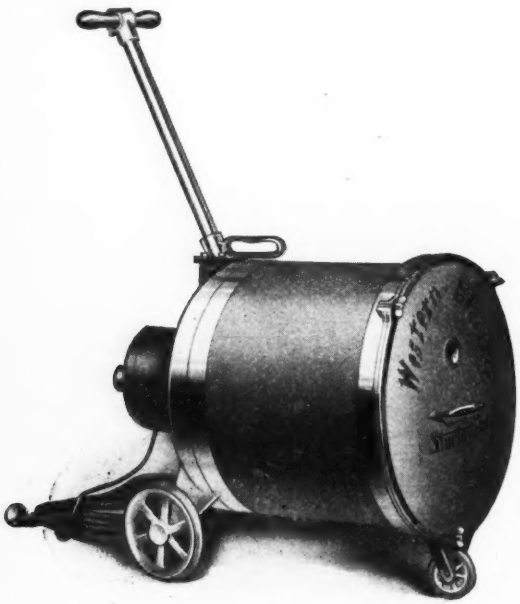
PROCEEDINGS OF THE NATIONAL DISTRICT HEATING ASSOCIATION for 1912, the first publication of which were destroyed in the Dayton flood last March, have been reprinted and distributed to members. The expense of reprinting was generously borne by individual members and friends of the association, who contributed a total of $445 for this purpose. The volume contains all of the papers read at the fourth annual convention in Detroit.

Modern Vacuum Cleaning Apparatus

12.—Western Electric-Sturtevant Vacuum Cleaners.

The Western Electric-Sturtevant vacuum cleaners are intended to provide a means by which all sizes of buildings, from the small house up to the large theatre, office building or hotel, may be dustlessly cleaned, without wear to fine furnishings, upheaval within the apartment or hard labor on the part of the servants. The principle upon which these machines operate is a simple one, and while the company manufactures several types of cleaners, each with its full line of sizes, the same principle of operation applies to each.

A motor mounted on the cleaner has an extended shaft to which is fastened a fan of special design.. In the portable types there is but one fan and the motor is mounted with its shaft in a horizontal position. The stationary types have compound fans and the motors are mounted on the top of the casing. The shaft, with the parts it carries, is the only moving part of the machine.. There are no gears or belts, pumps, bellows, diaphragms or reciprocating parts.



WESTERN ELECTRIC-STURTEVANT PORTABLE VACUUM CLEANER.

In the portable cleaners there is a dust bag enclosed in the body of the cleaner which may be removed for emptying by removing two catches holding the cover of the cleaner casing. The case and frame are usually made of aluminum tubing, with an ebony cross handle. Rubber tired wheels are used to prevent the scratching of polished floors. The cleaner is propelled by hand over rugs and thresholds, may be readily taken up or down stairs and does not easily topple over. An idea of its lightness may be gained from the fact that it can be pulled along by the hose.

TYPE OF WESTERN ELECTRIC-STURTEVANT PORTABLE VACUUM CLEANER, WITH RENOVATOR ATTACHED.

In appearance the Western Electric-Sturtevant stationary cleaner is a vertical cylinder, upon the top of which is mounted a motor. Directly below this and within a cylindrical casing are the fans, fastened upon the motor shaft and revolving with it. The number of fans used in a cleaner depends upon the power and the capacity required. Below the fans there is a dust chamber, which contains a dust screen, and at the bottom is a drawer into which the dirt falls and which may be taken out when necessary for emptying.

The movement of the fans creates a suction which draws air in through a connection on the side of the casing and which is connected with the suction pipe. When cleaning, the dirt drawn in by the air enters the casing at this point and, owing to the construction of the interior, it is carried around the inside so that the dirt is separated from the air by centrifugal force and falls into the dust pan below. The air is then drawn upward through a cloth screen which permits the passage of air but stops

any fine dust which may not have been deposited in the drawer. The air then passes through the fans and is blown out through a connection in the top of the casing, which is usually piped to the chimney. Thus the air, having once been drawn from the apartment which is being cleaned is not allowed to re-enter the building, being expelled at once through the chimney.

For use in connection with these types of cleaners, the company furnishes a special handle and wall brush, by the use of which one can clean over the tops of doors, plate rails, tops of picture frames, sideboards, etc., without any climbing or inconvenience. Walls and woodwork may be cleaned in the same manner.. Another special tool is provided for cleaning and airing fine draperies and curtains as they hang.

WESTERN-ELECTRIC STATIONARY VACUUM CLEANER.

The Western Electric-Sturtevant vacuum cleaners are marketed by the Western Electric Co., 463 West St., New York.

1912 Year Book of the Merchants' Association of New York.

In the 1912 year book of the Merchants' Association of New York, which has just been published, is a classification of the members of the association by trades, or lines of business.

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